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ENGINEERING NEWS.

ASPHALT PAVEMENT was ordered, at the last meeting of the Board of Estimate and Apportionment of this city, for the Boulevard, Lexington Ave. in part and Broad St. between Wall and Exchange place. The Boulevard pavement will cost $204,000 Lexington Ave. $87,000, and Broad St., $8,000; including the streets ordered to be paved with granite blocks on concrete, the total cost of paving ordered at this meeting amounted to $661,500. The issue of $700,000 in bonds was ordered to meet this proposed expenditure. At the same meeting Commissioner GILROY was authorized to pay out of the Paving Fund a consulting engineer at $5,000 per annum, an assistant at $2,500, two transitmen at $1,500 each, two levellers at $1,200, four rodmen at $1,000 each, one draughtsman at $1,500, and two skilled laborers and four axemen at $2.50 per day each. The City Comptroller was also allowed an engineer at $2,500 to inspect the work before making payment. From this action it would seem that Commissioner GILROY is not to pay his consulting engineer, after all, out of the salary of the discontinued office of Consulting Engineer of Sewers, as was at the time reported.

THE MANHATTAN ELEVATED ROADS appealed several years ago against a heavy award for damages to property of WM. Y. MORTIMER and others in the Bowery. The elevated company raised the point that, as to streets laid out while New York was in possession of the Dutch, the owners have no right or interest in the land embraced within the street limits. Judges FREEMAN and TRUAX have now sent in opinions affirming the judgment. Judge TRUAX holds that the fee in the street was never owned by the Dutch, and the English never admitted that they did. The English always claimed this region by right of prior discovery of the CABOTS, and the purchase of Manhattan Island from the Indians conveyed no title that could be recognized in United States Courts. The evidence also that the Bowery was a street in 1656 is not very conclusive, for while it was referred to in a grant by GOV. KIEFFT, "Bowery" also then meant a farm. Judge FREEMAN says it is not a question of international law, but must be decided purely between the public authorities of the State of New York and the citizens of that State. The foundations of the rights of abutters on streets laid out by the Dutch, as against the City or State, rest upon English common law, and are not affected by Dutch or Roman laws.

OAKLAND HARBOR, California, is being improved by a tidal canal now under construction by the Government. The canal will extend from the north end of San Antonio estuary to Leandro bay. The San Francisco Bridge Co. obtained the contract, and commenced work on Jan. 1, last, and by the terms of their agreement, 45,000 cu. yds. of earth must be moved per month, and the whole work is to be completed within one year. The canal will be 2 miles long, 400 ft. wide, and 8 ft. deep at low water, or have an average depth of 15 ft. The soil is sandy and is being moved by steam shovels, while a powerful dredge is at work near the entrance of the canal, arranged to convey the débris to low-lying lands by a floating tube. The present contract amounts to $300,000, but $500,000 more will be required to complete it.

HELENA, MONT., is figuring on a new water supply, and G. N. MILLER, C. E., has presented an elaborate report covering the possible sources of supply. Mr. MILLER favors Lump Gulch as a source, with a gravity supply costing $858,000. The plan includes a dam of masonry 40 ft. high, impounding 50,000,000 galls. of water, a 16-in. supply main, 13 miles long, two distributing reservoirs, etc. The present consumption of water in Helena is 2,000,000 galls. daily. These works would supply a city of 100,000 inhabitants.

AGITATION OF THE 1892 EXPOSITION PROJECT continues, but so far amounts to little but agitation. The Finance Committee has met and organized, choosing a Chairman and Executive Committee of seven, who are first to study over the forty or more projects which public-spirited citizens have submitted, after which, we trust, they will submit some definite project of their own. Considering that the committee represented $200,000,000 to $300,000,000 of property owned, it would have been a most graceful and effective act, which would probably have settled the question of holding the exposition in New York, had they made some suggestion toward personal subscriptions of a million or two as a starter; but so far, there has been a plentiful lack of definite offers of cash, beyond small sums for soda-water and peanut privileges, and such like, which have at least secured a momentary notoriety for the bidders, as they have been all given in full in the newspapers.

THE ENGINEERS' CLUB DINNER, given last Tuesday to the American engineers just returned from the famous European trip, was a brilliant success. About 100 guests and members of the club sat down to the feast in the club house, with Mr. BAYLES presiding in the absence of Mr. BURDEN, the Club president. When time came for the speech-making Messrs. TOWNE, KIRCHOFF, T. C. CLARKE, FREEMAN and others spoke for the traveled contingent, and testified again and again to the hearty hospitality of their foreign brethern, and Messrs. ADAMS, HOLLOWAY, LORING, LEWIS and others spoke for the stay-at-homes. A notable speech was made by Mr. GERING, engineer-in-chief of the *City of New York*, who as an invited guest answered in part for English engineers and told his hearers what a five days' passage of the Atlantic really meant. This enjoyable and memorable dinner was closed by a talk from Dr. R. W. RAYMOND, who in his happiest vein attempted to convince the pilgrims that, as far as the members of the American Society of Mining Engineers who had to stay at home were concerned, "they too had not been idle," inasmuch as the Denver meeting held this summer was one of the very best in the history of the Society.

A BRIDGE, 258 ft. long and weighing 250 tons, was moved 45 ft. in 12 minutes, on Mill creek on the Pennsylvania R. R., on Aug. 11. The work was in charge of Master Carpenter W. K. BEARD, of the Pennsylvania R. R., with 100 men. The bridge was 35 ft. wide and 10 ft. deep; it was moved by rollers and jacks on to 78 timber trestles from 3 to 28 ft. high. This bridge will now be replaced by a stone arch structure 300 ft. long, with four arches and a width sufficient for three tracks, which is to be completed by January 1, next.

THE DIRECTORS OF THE NORTHERN PACIFIC RAILWAY CO. have voted to submit the financial plan recently devised by HENRY VILLARD to the vote of the preferred stockholders. The plan, similar to that of the Chicago, Milwaukee & St. Paul R. R. Co., noted in these columns some time ago, is to issue a blanket mortgage of large amount at a low rate of interest covering the entire property, in place of several small mortgages on different portions of the property, and bearing a high rate of interest. The amount of the consolidated mortgage is $160,000,000, which will be used in retiring the outstanding first, second, and third mortgage bonds and all other securities guaranteed by the company, and which is also to be applied to other financial needs of the company, both present and future. It is not intended at present to market more than $15,000,000 of these bonds, which will be sufficient to relieve the present needs of the company. The plan by which the outstanding bonds are to be retired and the new issue marketed has not been made public, nor has the rate of interest which the consolidated mortgage will bear been decided upon.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment of an excursion trian Aug. 16, near Sarver's station, on the Butler branch of the West Pennsylvania Ry. The accident was caused by the spreading of the rails on the end of a small bridge over Buffalo creek, and it is stated that the stringers on which the rails were laid were badly rotted, so that the spikes had not a firm hold. The train consisted of an engine and three cars; the engine and one car remained on the track, one car going down a 15-ft. bank, and the third car going partly down the bank. Three persons were killed and 19 injured. This accident is the latest addition to a long list of similar accidents, and should serve as a lesson to a good many railways.——A derailment accident occurred Aug. 18, to a passenger train on the Burlington & Missouri River Ry., near Lincoln, Neb. A switch was misplaced while the train was passing over it and two cars were derailed, one going down a bank. A broken brake-beam is said to have caused the accident, which a switch lock might have prevented.——A crossing collision occurred at Memphis, Tenn., Aug. 13, between a freight train and a train on the local dummy line. The engineer of the dummy reversed when he saw the freight, but his engine was wrecked. It is said that neither of the trains stopped before reaching the crossing.

ANOTHER SERIOUS RAILWAY ACCIDENT occurred Aug. 22 on the Knoxville, Cumberland Gap & Louisville Railway. The line is a new one, and the train was the first one run over it. The rear car was derailed at a crossing near a trestle, ran onto the trestle and then went over the edge, falling 30 ft. into a creek. Three persons were killed and 31 more or less seriously injured.

A QUITE SERIOUS ACCIDENT, injuring 18 persons, several of them very severely, happened to a Burlington & Missouri river train near Lincoln, Neb., from the breaking of a brake-beam just before reaching a swtich. The switch was forced open and the train derailed; the moral being that brake-beams should not be hung so that any single breakage can permit them to drop in the track. It is singular how long it takes to have this simple fact appreciated, when it would cost so little to avoid all possibility of such accidents.

BRIDGE AND TRESTLE ACCIDENTS are reported as follows: A trestle on the Fort Branch division of the Evansville & Terre Haute Ry., near Mt. Vernon, Ind., gave way under a passenger train Aug. 14. No one was killed.——Bridges have been washed away on the Denver & Rio Grande, Atchison, Topeka & Santa Fé and Southern Kansas railways. Several bridges in New Jersey have been washed out.

THE HEAVY STORMS of the past week have occurred in Colorado, Nebraska, Kansas, and Missouri; land was flooded, bridges carried away, and railways washed out. At Lincoln, Neb., the flood was the worst known for some years. Heavy rains also caused the flooding of some parts of Philadelphia. Near St. Clair, Pa., the dams at Johns and Mt. Hope burst on Aug. 14. Extensive washouts have occurred in South Carolina, due to heavy rainstorms.

A CIRCULAR ON THE 24 O'CLOCK SYSTEM has been issued by the American Society of Civil Engineers to railway officers and members, accompanied by a pamphlet report of the committee and list of officers, managers, engineers, superintendents, and others, who favor the movement. The prospect is regarded as favorable, and we trust it is. The movement is a sensible one abstractly, but it is almost as hard to make 100,000,000 of people say "20 o'clock" instead of "8 o'clock" as it would be to make them substitute the word "twenty" for the word "eight." For railway time-tables, however, the obstacles are less, while the advantages ar great; and through time-tables the public may become accustomed, in time, to the general use of the system.

THE SOUTH FORK FISHING CLUB has filed a plea of Not Guilty in the case of NANCY W. LITTLE and child against the Club for the loss of husband and father by the Johnstown flood. The plea of the Club was a voluntary one, and shows that it is not shirking the issue.

THE WASHINGTON SEWERAGE COMMISSION, Messrs. HERING, GRAY, and STEARNS, have had a meeting with the President, and have received from him some very general directions. They are now at work with Capt. LUSK studying the present plans of sewage disposal.

THREE GREAT RAILWAYS OF ENGLAND held their half-yearly meetings in London on Aug. 9,—the Northeastern, the Midland, and the Great Northern lines. These roads represent an aggregate outlay of about $900,000,000, on which amount the average yearly return does not exceed 4 per cent. In the past half-year the Northeastern carried 17,099,000 passengers, the Midland, 16,126,000, and the Great Northen 13,256,000, or an aggregate of 46,500,000 in six months. Of this number it is figured that 164 out of every 170 passengers traveled third-class, and 3 travelled as first-class and 3 more as second-class passengers. Under these conditions it is only natural to applaud the Midland's policy of abolishing the second class compartments altogether.

THE BRIDGE IRON TRUST brought about a meeting of bridge builders at Cleveland, O., on Aug. 15. As reported, the meeting favored establishing a mill of its own as a means of breaking the combination which keeps up the price among the few mills now making iron suitable for bridge building.

THE CONGO RAILWAY CO., from Matadi to Stanley Pool, has been officially organized in Brussels with a capital of $5,000,000. The president is G. SABATHIER, and JULES URBAN is chairman of the permanent committee. As set forth in the London prospectus, this road, projected to avoid the cataract region of the Lower Congo, will be 271 miles long, of which only 16 miles present any great difficulties of construction. The navigable system of the Upper Congo is now traversed by 17 steamers, which are to be increased at once. The Congo Government has granted a concession for 99 years, with a land grant of about 1,620,000 acres, in addition to a belt one-eighth of a mile wide on each side of the line.

A NEW FIRE-PROOF NON CONDUCTOR FOR PIPES AND BOILERS is manufactured by the H. W. Johns Manufacturing Co., of New York. It is called Asbestosponge, and in it the barb like filaments of the sponge, as here prepared, are so interwoven with the fine fibre of the asbestos as to make a covering both very elastic and highly porous; a barrel of it, as prepared for use, weighs only 50 lbs. The percentage of sponge is so small that the material is practically fireproof, and pipes carrying steam under 100 lbs. pressure have been covered with this material for several months without affecting the vitality or "spring" of the covering. This new material has double the covering capacity of hair felt for the same weight, and three times that of pure asbestos, making it much cheaper than other materials intended for a like purpose. It is furnished in the form of felts and also dry in barrels to be mixed with water and applied like a cement. The same company manufactures fireproof asbestos cloth for theatre curtains, aprons, etc., and also an asbestos building felt that is being widely used for floor and partition linings, etc.

WATER COMPETITION is demanded by the *Kansas City Times* as the only permanent means of keeping rates down. It is proposed to improve the Missouri river between St. Louis and Kansas City and make it a navigable stream. To do this some appropriations will have to be secured in the next River and Harbor bill, and capital will then have to be secured for investment in a steamboat line. Evidently the prospects of water competition on the Missouri are rather remote.

The General Location of Railway Lines with Reference to Sources of Traffic.

The following constitutes the first part of Chapter XXI. on "Trunk Lines and Branch Lines" of Mr. WELLINGTON'S "Economic Theory of the Location of Railways." We reprint it in advance of an editorial discussion, to follow next week, and as the part of the volume which is regarded by the author as at once the most important and the most novel; dealing with a phase of the railway problem which has attracted little attention either from engineers or projectors, yet which is in reality the most important of all for many lines.

That the most elementary conditions on which the success or failure of railway enterprises depend are often radically misunderstood, almost necessarily follows from the fact that the world is so full of examples of misdirected enterprise—of lines built with great hopes of profit which have proved miserable failures; while, on the other hand, there are so many examples of roads built for local purposes, or otherwise without particular expectation of a brilliant future, which have proved magnificent properties. Among innumerable examples which might be mentioned, we may take the West Shore Railroad of New York as an example of the first class, and the parallel New York Central of the last; the present New York Central & Hudson River Railroad having been made up by the consolidation of six or eight different local lines, built with little or no reference to the formation of a great trunk line. These two lines are, in their different ways, striking examples of the fact that the conditions which control the future prosperity of such properties are often wholly misunderstood.

It seems for many reasons probable that by far the larger part of this very general misunderstanding—of the blundering into unexpected success on the one hand, and into dismal and utter failure on the other—arises from a single cause, viz., an imperfect understanding of certain elementary facts, which we will now consider, as to the effect upon the productiveness of the property of any increase in the sources of traffic. The unexpectedly good or bad fortune of hundreds of properties can be traced, in part or whole, to this single cause.

FIG. 233.

Let us suppose a railway to be projected, say 100 miles long, to connect two traffic points of some importance, *A*, *B*, Fig. 233. We will assume for simplicity that there is little or no intermediate local traffic, as often happens. We will consider *A* and *B* to be equal, not necessarily in population, but in traffic-contributing capacity to this particular line. The traffic which the railway has to support it may be then represented by the combination *AB*, being that which naturally exists between two traffic points of the importance of *A* and *B*.

FIG. 234.

Let us now suppose that another alternate route may be chosen, which by a slight detour will strike an intermediate traffic point *C*, Fig. 234, of equal potential magnitude with *A* and *B*: how have we affected the revenue-earning capacity of the line?

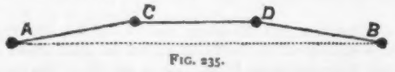


FIG. 235.

A most natural answer—beyond all question a very common answer—is that we have increased it just 50 per cent. Instead of serving perhaps 100,000 people in the two towns *A* and *B*, we now serve 150,000 people in the three towns *A*, *B*, *C*. Fifty per cent. more people, fifty per cent. more traffic, fifty per cent. more earnings—seem natural corollaries of each other.

FIG. 236.

On the contrary, it may be shown at once that we have doubled our probable traffic, and really we have tripled our traffic, and rather more than tripled it. Instead of having only Traffic *AB*, Fig. 233, we have Traffic *AB* Traffic *AC*, Traffic *CB*, Fig. 234.

The value of the latter is obviously twice, and really considerably more than three times, that of the former To have the traffic tripled we must assume that Traffic *AB*, Traffic *AC*, and Traffic *BC*, Fig. 234, are of equal financial value—which they are, as nearly as may be.

An objection to this statement will naturally suggest itself—that in Fig. 234, although the traffic points *A*, *B*, *C* are equal in magnitude, yet the haul on the Traffic *AB* is twice that on Traffic *AC* or *CB*. Therefore, if the volume of each be the same and the rates be the same, we apparently have Traffic *AB* = Traffic *AC* + Traffic *CB*, so that we have only doubled instead of tripling our traffic from a revenue-producing point of view.

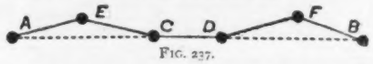


FIG. 237.

But these latter assumptions are not correct, either as respects the volume of or rates on traffic.

As respects the effect of distance, it may be said in a general way that, if we consider only great and decided differences of distance, the volume of traffic, both passenger and freight, will be at least inversely as the distance; that is to say, if two given traffic points, 100 miles apart, could be moved up to a distance of only 50 miles from each other, and remain otherwise unchanged, the volume of traffic between them will be at least doubled. New York and Philadelphia, for example, are 90 miles apart, and New York and Boston 231 miles. Could these cities be moved up to within 45 and 115 miles of each other, the volume of traffic between them might even be quadrupled, and certainly the lines connecting them would be very much better properties, because the loss of haul would be more than made up by the increase of volume, even as respects gross revenue, leaving the saving in expenses by the shorter haul and the probable higher rates per mile almost a clear gain.

As to rates, it is an entirely safe general rule, that freight hauled only half as far will pay a materially larger rate per mile for the haulage proper, excluding terminal charge, which is in effect a part of every rate.

The passenger rates per mile might well be the same or even lower, but this would only be for the reason that it was profitable to make them lower, to secure the far greater net gain from the increase of volume. The traffic would in all such cases bear a materially higher rate per mile without decreasing its volume below what would exist with twice the haul. Taking both these considerations together, it is quite certain that, whether we consider great distances or small, nearness of traffic points is certainly no disadvantage to the financial productiveness per unit of the traffic between them. For example, if the haul on wheat to the seaboard were only half as great, it cannot be questioned that it would be a more profitable traffic, and it would possibly pay quite as large gross rates. The New York-Newark traffic, 9 miles, is far more profitable and far larger in the aggregate, in proportion to the size of the two places, than the New-York-Philadelphia traffic, 90 miles. If Philadelphia were as near to New York as Newark, both the volume and the productive value of their interchanged traffic would be enormously greater than it is now.

There are, of course, certain possible exceptions to this general rule. The tonnage between the anthracite-coal mines and New York, for example, might not be much larger than it is if the haul were only 50 miles instead of 150, for about so much must be had at any cost, and more than that is not needed. And yet it probably would be larger, both because the more favorable conditions for coal supply would have greatly stimulated manufactures, and so the growth of population as well, and because the rates per mile hauled would be higher.

We see, therefore, the reasons why, assuming the points *A*, *B*, *C*, Fig. 234 to be of inherently equal traffic-producing capacity, the short-haul traffics, *AC* and *CB*, should each one of them be of more rather than less value than the long-haul traffic, *AB*; from which it follows that the aggregate of three traffics *AB*, *AC*, *CB*, Fig. 234, will be worth more rather than less than three times as much as the traffic *AB* alone.

This being determined, let us now extend the inquiry by determining, in the same manner as above, the probable comparative traffic on five different lines of any common length, Figs. 233-237, having two, three, four, five and six traffic points on them, each point being assumed, for the sake of simplicity, to be of equal traffic-producing capacity.

We then have,

In Fig.			Traffic Units.	Comparative Traffic.
233,	2 traffic points,		*A B* only,	1
234,	3 "	"	*AB, AC, CB,*	3
235,	4 "	"	*AB, AC, CB, AD, BD, CD,*	6
236,	5 "	"	*AB, AC, CB, AD, BD, CD, AE, BE, CE, DE,*	10
237,	6 "	"	*AB, AC, CB, AD, BD, CD, AE, BE, CE, DE, AF, BF, CF, DF, EF,*	15

Comparing Fig. 233 with Fig. 237, by multiplying our traffic points by *three* we have multiplied the traffic by *fifteen*, or have increased the productiveness of each separate traffic point five times.

This process, with certain corollaries which follow therefrom, is extended somewhat further in Table 191 and illustrated graphically in Fig. 238.

It will be seen from Fig. 238 that when, on any given line with any given number of traffic points of equal weight on it, we have:

No. of traffic points,

2 | 3 | 4 | ... n,

We have for the comparative traffic,

1 | 1+2 | 1+2+3 | 1+2+3+...+$(n-1)$,

In other words, the comparative aggregate traffic for any number of traffic points n is given by the sum of the natural numbers to $n-1$ inclusive. The sum of such a series to n inclusive is given by the formula

$$S = \frac{n(n+1)}{2} = \frac{n^2+n}{2} \quad \ldots\ldots (1)$$

So that for the aggregate traffic T, due to n traffic points, we have

$$T = f\frac{(n-1)^2+(n-1)}{2} = f\frac{n(n-1)}{2} \quad \ldots (2)$$

f being any coefficient.

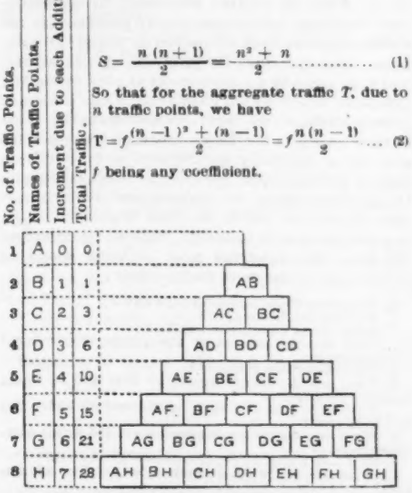

No. of Traffic Points.
Names of Traffic Points.
Increment due to each Addition.
Total Traffic.
1 A 0 0
2 B 1 1 AB
3 C 2 3 AC BC
4 D 3 6 AD BD CD
5 E 4 10 AE BE CE DE
6 F 5 15 AF BF CF DF EF
7 G 6 21 AG BG CG DG EG FG
8 H 7 28 AH BH CH DH EH FH GH

FIG. 238.—Illustrating the law of increment in traffic resulting from the interpolation of the additional traffic points *C*, *D*, *E*, *F*, etc., Figs. 233 to 238.

For any large number of points N we have similarly

$$T = f\frac{N(N-1)}{2}; \quad \ldots\ldots (3)$$

whence the ratio of increase is

$$\frac{T}{T} = \frac{N(N-1)}{n(n-1)} \quad \ldots\ldots (4)$$

As n becomes a larger number, the ratio of n to $n-1$ becomes more and more nearly unity, until finally the ratio of T to T becomes sensibly

$$\frac{T}{T} = \frac{N^2}{n^2} \quad \ldots\ldots (5)$$

which is the equation giving the general law of increase in earnings due to an increase of tributary traffic points on the same length of line; i. e., the productive traffic varies as the *square* of the number of tributary sources of traffic.

TABLE 191.

SHOWING THE EFFECT UPON AGGREGATE TRAFFIC OF INTERPOLATING ADDITIONAL TRAFFIC POINTS IN THE LINE.

[See Figs. 233-238.]

No. of traffic points	Relative traffic	Traffic per unit of population	Per cent. increase of traffic by adding one traffic point	Absolute increase of traffic by adding one traffic point
2	1	0.5	.....	.....
3	3	1.0	200.0	2
4	6	1.5	100.0	3
5	10	2.0	66.7	4
6	15	2.5	50.0	5
7	21	3.0	40.0	6
8	28	3.5	33.3	7
9	36	4.0	28.6	8
10	45	4.5	25.0	9
11	55	5.0	22.2	10
12	66	5.5	20.0	11
13	78	6.0	18.2	12
14	91	6.5	16.7	13
15	105	7.0	15.4	14
etc.	etc.	etc.	etc.	etc.

It will be seen from the last column of this table that the *absolute* gain from a given addition of tributary population is greater in proportion to the amount of other tributary population, but that the addition *per cent.* is very much greater on light-traffic roads

TABLE 192.

GROWTH OF NEW YORK CITY INTERNAL PASSENGER TRAFFIC.

[Compare tables noted below.]

Year	Estimated and actual population	City Passenger Traffic (Thousands) El'va'd roads	Horse cars	Total	Per Inhabitant E'd	H'rse	Total
1853	581.	None		6,896	....	11.8	11.8
54	605.	"		6,817	....	11.3	11.3
1855	629,810	"		18,488	....	29.4	29.4
56	653.	"		23,153	....	35.0	35.0
57	698.	"		22,190	....	31.9	31.9
58	734.	"		27,900	....	38.0	38.0
59	773.	"	Same as	32,889	....	42.7	42.7
1860	813,669	"	next	36,455	....	44.7	44.7
61	826.	"		26,272	....	31.8	31.8
62	838.	"	column	35,878	....	42.8	42.8
63	850.	"		40,412	....	47.6	47.6
64	863.	"		60,900	....	70.6	70.6
1865	876.	.....		82,055	....	93.8	93.8
66	889.	.....		88,953	....	100.0	100.0
67	902.	.....		100,542	....	111.0	111.0
68	915.	.....		105 817	....	115.6	115.6
69	929.	.....		114,349	....	123.5	123.5
1870	942,292	.....		115,139	....	122.0	122.0
71	962.	.....		133,894	....	139.4	139.4
72	982.	136	143,561	143.697	0.1	146.0	146.1
73	1,003.	644	144,715	145.359	0.6	144.4	145.0
74	1,024.	796	151,131	151,927	0.8	147.8	148.6
1875	1,045,223	921	165,997	166,918	0.9	158.8	159.7
76	1,076.	2,013	166,401	168,414	1.9	154.5	156.4
77	1,107.	3,012	160,924	163,936	2.7	135.3	148.0
78	1 139.	9,291	160,899	170,190	8.1	131.0	149.1
79	1,172.	46,045	141,939	187,984	39.4	121.4	160.8
1880	1,206,299	60,832	150,390	211,222	50.5	124.7	175.2
81	1,242.	75,586	155,801	231,387	60.8	125.4	186.2
82	1,278.	86,361	166,511	252,872	67.6	130.8	198.4
83	1,315.	92,125	176,625	268,750	70.1	134.2	204.3
84	1,354.	96,706	187,413	284,116	71.5	138.2	219.7
1885	1,393.	103,355	193,762	297,117	74.2	139.0	213.2

In the years 1871-72-73, the report of the American Society of Civil Engineers shows 3,000,000 to 5,000,000 more passengers per year than above, probably by inclusion of some omitted line, but it has not been attempted to correct the error.

SUMMARY.

Year	Population	Trips per inhabitant Horse	Elevat'd	Total	No. of lines. Horse'	Elevat'd	No. trips per inhabitant per 100,000 of population.
1853....	581	11.8	.....	11.8	2	.....	2.03
1855....	630	29.4	.....	29.4	4	.....	4.67
1860....	814	44.7	.....	44.7	6	.....	5.5
1865....	876	93 8	.....	93.8	12	.....	10.7
1870 ..	942	122.0	.....	122.0	12	.....	13.0
1875....	1,045	158.8	0.9	159 7	19	1	15.3
1880....	1,206	124.7	50 5	175.2	23	4	14 5
1885....	1,393	139.0	74.2	213.1	25	4	15.4
1890....	.....	.....	.....	.....	.....	.....	.....

Since 1885 a further and great increase has begun, so that there is every prospect that it will be more notable in proportion than heretofore.

While the growth of city travel is in some respects a special problem, since its increase results in great part from the increasing distances which larger population brings, yet it is mainly but one expression of a general law brought out in Chap. XXI., that traffic tends to increase about as the *square* of the population or sources of traffic united by convenient means of communication. Quite as forcible an illustration of this law is obtained by studying the growth of traffic of States and the United States as elsewhere presented. Compare Tables 14, 15, 16; also Tables 2, 3, 7, 21 to 28, 34, etc.

It is plain that we cannot always, nor ordinarily, count on any series of points *A*, *B*, *C*, *D*, *E*, etc., each of which is exactly equal to each other, but we may push the generalization a little farther.

Taking the entire population of a country, or of a continent, or of the world, and conceiving it to be made up of a great number of units, either of single individuals or of groups of 10, 100, 1,000 or 1,000,000 individuals, it is plain that each one of these units has potential traffic relations with every other unit. The components of each unit visit those of the other socially; they buy and sell from each other; they visit each other in the hope of buying and selling; they produce more (this is an invariable law) for the especial purpose of supplying the necessities of others with whom they have or finally secure traffic relations. Until such traffic facilities exist, these relations are inchoate, or merely potential. As the facilities are extended, they become actual; and they should tend to become actual, if our reasoning has been correct, about in proportion to the square of the facilities afforded, and of the population served. Experience seems to show that they do tend to increase about in this ratio, some evidence of which fact is contained in Table 192, as also in Tables 14, 15, 16, and others referred to below Table 192; but however this may be, that they increase in very much more than direct ratio is beyond all question.

It is therefore unnecessary to take each individual town as a traffic unit, as we have done heretofore. We may regard each individual person as the traffic unit; and while it will be by no means literally true that he will have actual traffic relations with all those for whom the facilities exist, but only with every tenth, hundredth, thousandth, or millionth person, according to his character and occupation, yet practically the result is the same. His aggregate contributions to railway traffic will vary in close accordance with the total population connected with him by traffic facilities, and his payments to any particular line will be in direct proportion to that fraction of the total of the whole population connected with him by traffic facilities which is reached by him over that particular line.

We have thus only to consider the points *A*, *B*, *C*, *D*, *E*, Figs. 233-237, to represent single individuals instead of towns or other traffic points, and to consider their number n to be indefinitely multiplied, when precisely the same process of reasoning we have just applied to towns leads to precisely the same conclusion as respects individuals.

We then have $n(n-1) = n^2$ [Eqs. (4) and (5)] almost exactly; whence, if P = the actual tributary population, on the line, and p = a possible additional population, the percentage of increase in traffic L, all other things being equal, will be,

$$L = \frac{(P+p)^2}{P^2} \quad \ldots\ldots (6)$$

In other words, if we have 1,000,000 tributary population and can add 100,000 more, each unit of which is of the same traffic-producing capacity, the increase will be

$$\frac{(10+1)^2}{10^2} - 1 = 21 \text{ per cent.}$$

If our original population were 500,000, we should have, all other things being equal,

$$\frac{(5+1)^2}{5^2} - 1 = 44 \text{ per cent.}$$

This is really a more correct way of arriving at the theoretical effect of additional sources of traffic than that used in Table 191, since it takes each individual as the unit, instead of a group of 20 000 or 100,000. It gives a somewhat smaller percentage, but the difference is not great enough to make a material difference in what are at best merely illustrative computations, not susceptible, nor supposed to be susceptible, of exact application in practice, except as indicating the comparative probable revenue, all other things being equal, of alternate routes between the same termini.

In any actual instance, of course, all other things would be more or less unequal, and hardly any of them equal, so that it would be quite impossible to make any very precise estimates by the formula given. In the first place, it is impossible to more than guess at the true tributary population. That which is apparently tributary, from being on the line, is decreased by the competition of other lines, so that only a fraction of it is really tributary; while, on the other hand, there may be an immense population beyond the limits of the line itself which is indirectly tributary to it through the medium of other lines, as in the case of the trunk lines from the sea coast to the West. In the second place, a mere enumeration of heads is a very rude index of the traffic value of those heads. A great mining, or manufacturing, or commercial point will contribute vastly more traffic per head than other more inert communities, and a large town, almost always, more per head than a small town.

Nevertheless, when we connect Smithville with our line, we get the New-York-Smithville as well as the Smithville-New-York traffic; and the traffic of New York is made up only of the aggregate of that to thousands of Smithvilles, of which we get those which we reach in one way or another by our line. Thus the discrepancy on account of the difference in the traffic-producing capacity of individuals is less than might be supposed, and Tables 14, 15, 16, and 191, with various others in this volume, show that the law holds tolerably well when applied on a large enough scale to eliminate sources of irregularity, while there are innumerable examples of single lines whose prosperity or adversity can be directly shown to imply the existence of some such law.

These fundamental truths being granted, therefore, it leads very directly to certain conclusions as to the proper manner of laying out both trunk lines and branch lines,—conclusions which, while they may be difficult to apply so exactly as to avoid a considerable percentage of error will yet be so definite that the radical error of mistaking black for white, so to speak,—taking that for the best course which is rather the worst course,—is not likely to occur.

The chapter then continues with a more detailed discussion of the proper application of the preceding conclusions to practical cases, for which we cannot give the space.

Automatic Air-Valves.

It is one of the elementary lessons which every steam-heating engineer has to learn that steam will not flow into a pipe before the air flows out. The two bodies cannot occupy the same space any more than two solids, although they may mix to some extent. The first means adopted for removing air from the heating pipes, and that which is still almost universally in use, was a small screw-valve or "pet cock." As the necessary area of opening of such a valve is exceedingly small, it is generally made in the simplest possible style, and is therefore quite inexpensive.

A great many comfort-loving inventors, however, have awakened on a winter morning to find their sleeping room at an unpleasantly cool temperature and the radiator quite cold until the air-valve was opened to permit it to fill with steam, and as they lay waiting for the room to grow comfortable before rising they have speculated on a plan to make the air-valve take care of itself and open and shut at the right time. Nor is this the only case where automatic air-valves are desirable. In large buildings heated by steam it is no small task for a janitor to go the rounds of all the radiators and open and shut the air-valves. In general any device which works automatically and requires no attention is always preferable, other things being equal, to one which requires some looking after, even at infrequent intervals.

The first type of automatic air-valves used were operated on the familiar principle of the different rates of expansion of different metals when heated. Strips of two dissimilar metals were joined together in such a manner that the motion from their unequal expansion when heated to the temperature of the escaping steam would close the orifice leading from the outer air into the steam space of the radiator. The well-known Davis valve acts on this principle, and it has perhaps the widest reputation of any valve of this type which has been put on the market. The metal strips are enclosed in a cylindrical case 7⅛ ins. long and ¼ in. diameter, which is attached to the radiator tube. These valves generally work very well, but in the course of time corrosion sometimes takes place between the two metals at their junction points, and any motion there, even the slightest, is likely to render the valve useless. In case this occurs so that the valve does not close, steam will escape all the time, and this unpleasant condition of affairs generally necessitates a visit from the plumber and the replacing of the old valve by a new.

The most serious defects of this valve, and of all other valves of this type with which we are familiar, are its cost and the space that it occupies. Each valve costs from 75 cents to $1, and as in the majority of steam-fitting jobs, expense is an important consideration, this alone has limited its use to the best class of work. Its considerable length, too, makes it liable to receive hard knocks, which may cause a leak; and on the whole it was never likely to come into general use.

About three years ago Mr. JENKINS, the inventor of the well-known Jenkins packing, conceived the idea of utilizing the different rates of expansion of metals and rubber compositions for the construction of an automatic air valve. The result was the valve of which a cross-section is given here-with.

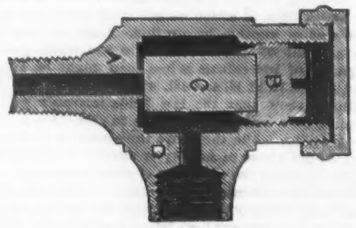


Fig. 1. The Jenkins Automatic-Air-Valve.

As will be seen, this valve is extremely simple. There are but four pieces. The brass body, *A*, is screwed into the radiator and opens into the steam space. *C* is a plug of Jenkins packing set in a head, *B*, by which it can be moved up against the orifice opening into the steam space. To set the valve, it is placed on the radiator with the plug well up from its seat, and steam is turned on. As soon as it is hot, the plug is turned on by a screw-driver until it touches the seat and steam stops escaping. When the radiator is cool, the difference in the rate of expansion of the brass and the plug *C* is enough to raise the plug very slightly from its seat and permit air to enter. When steam is again turned on, the air is expelled; but as soon as the steam begins to pass through the valve, the plug *C* expands and closes the passage. The lower side of the valve is tapped as shown to attach a drip pipe or drip cup. In case the valve should ever fail to work automatically, the plug *B* can be moved with a screw-driver. Neatly finished and nickle plated, one of these valves costs about 50 cts.

It is readily seen that these valves are in every way a great improvement over the type of valve first described, and although they have been on the market hardly two years, many thousand have been sold and their use is fast increasing. The only point of question in reference to them is the possibility that in time the plug of packing may lose its expansibility. As it is not exposed to the steam save on a very small area of its face, and as Jenkins packing is pretty durable anyway, there seems no reason why it should not last for many years. If it should require renewal, the cost of a new plug would be merely nominal. It is proper to say that Jenkins Bros. claim to cover by their patent all automatic air valves using an expansible refractory packing.

An air valve similar to the Jenkins was patented June 11, 1889, and has just been put on the market. The following cut shows a full-size cross section.

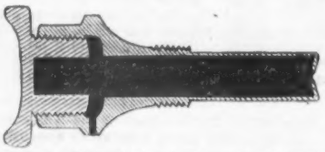


Fig. 2. The Victor Automatic Air-Valve.

The principle of operation is exactly the same as in the Jenkins, but the valve is considerably smaller. The composition plug is longer, however, and extends into the steam space, so that it is kept hot and will not open until the radiator becomes cool. At the same time, the plug, which is made of hard rubber composition, is protected from the direct action of the steam by a metal casing, as

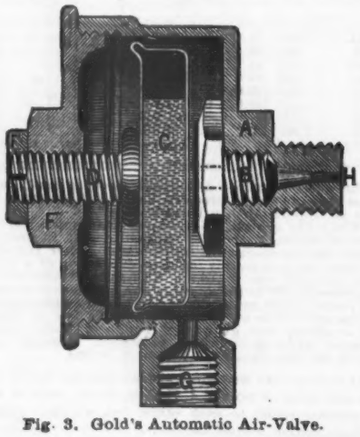


Fig. 3. Gold's Automatic Air-Valve.

shown. The inventor claims that no drip cup is ever needed with this valve, and the escape vent is therefore only a small orifice, as in some common styles of non-automatic valves. The valve is furnished either with a milled head or a slotted head for screw-driver. Either style costs about 40 cts. This valve has been christened the Victor. This valve is made by the Davis Automatic Air-Valve Co., Chicago., Ill. T. R. McMann & Bro., 58 Gold St., N. Y., are the Eastern agents.

A very ingenious valve, working on a quite different principle from the preceding, was patented at about the same time as the Jenkins valve, and is put on the market by the Gold Car Heating Co., corner Frankfort and Cliff Sts., this city. The following is a full-size cross-section.

This valve is necessarily more expensive and complicated than those just described. Its makers claim it to be also more sensitive, reliable, and durable. In the cut, *C* is a hollow brass diaphragm partly filled with a mixture of turpentine and alcohol, evaporating at a temperature considerably under 212°. When exposed to the heat of escaping steam, the pressure from the evaporation of this fluid presses out the flat sides of the diaphragm, and closes the inlet to the radiator. The seat against which the diaphragm closes is large and flexible, so that particles of dirt or pipe scale will not prevent the valve from closing. These valves are made either nickel-plated or plain, and cost from 80 cts. to $1 each.

Troy Civil Service Examination for Engineers.

The Municipal Civil Service Examiners, of Troy, N. Y., JOHN F. AHERN, President, in examining civil engineers for the position of engineer for the Public Improvement Commission, asked 99 questions. Eighty-four of the questions were as follows, and they compose an assortment at once varied and extensive, which would puzzle any of our readers to answer off-hand, we fancy, substituting the name of their own city for Troy. Some of the questions also seem decidedly superfluous and ill-judged; fully a third of them have little direct bearing on the qualifications of an engineer, and refer to matters which it is not in the least important for an engineer to have in memory. Still we imagine that the man who answered most of them would be likely to prove the most useful officer:

1. When was Troy incorporated a city?
2. Who was its first mayor?
3. Name thirty counties in the State.
4. What are the powers of the public improvement commission?
5. When was the law passed?
6. What are the official papers of Troy and by whom are they designated?
7. How is the cost of public improvements under this law to be paid?
8. What new duties are imposed upon the water commissioners?
9. By whom is cost of repaving streets to be paid?
10. Who lets the work recommended by the commission?
11. How is the work to be let?
12. What notice is to be given to bidders?
13. How are the expenses of the commission to be paid?
14. How is the share of the city to be paid?
15. What is the limit in the size of sewers at and beyond which one-half the cost shall be paid by the city?
16. Where is Crooked sewer, and what is its object?
17. How much did it cost?
18. When was it built?
19. Where is the Great South sewer? When was it built? What its cost?
20. What is the capacity of an egg-shaped sewer four feet wide and six feet deep?
21. What is the perimeter when two-thirds full? When one-half full? When one-quarter full?
22. What are the city offices?
23. What is the pressure per square inch on the base of a column of water one foot high?
24. Bound the State of New York.
25. How many cubic feet of water in one inch rainfall on one acre?
26. What was the date of Lincoln's assassination?
27. What was the date of Lee's surrender?
28. When was McClellan relieved of his command?
29. What is the longitude of Albany? Of San Francisco?
30. What longitude determines mountain time?
31. What is the fall of the Poestenkill within the city limits?
32. What are the valleys of drainage within the city limits, and what their general direction?
33. What, in your opinion, is the best system of ventilation for sewers? How are they ventilated?
34. What is the composition of sewer gas?
35. What is the difference between the mean temperature in sewers and in the open air?
36. What is the average rainfall?
37. What is the greatest recorded rainfall?
38. How long is the Hudson river?
39. How long is the Ohio river?
40. A circular island contains one square mile: what is its diameter?
41. The drivers of a locomotive are 6 ft. in diameter. How many revolutions between Troy and Albany, the distance being six miles?
42. How many lots 125x75 in 1 acre, 2 perches and 2⅘ yds.?
43. The shadow of a spire is 22⅘ ft. long; that of a ten-foot pole 2⅘ ft.: how high is the spire?
44. The volume of a cube is 76.12 cu. ft.: what is the length of its edge?
45. What is the average weight of solids voided by an adult? Of fluids?
46. Two spheres are as 27 to 243: what is the ratio of their diameters?
47. The radius of a circular sewer is five feet: what is the radius of a sewer having double the area of the first?
48. What is the price of four-foot flag?
49. What is the price of twenty-inch curb?
50. What has been the average cost of three-foot sewers in Troy?
51. What are the specified sizes of blocks for block pavement in Troy?
52. How many blocks are there to the square yard?
53. Where are the blocks obtained?
54. What has been the cost of block pavement in Troy?
55. What is the Russ pavement?
56. How many feet in a mile?
57. How many bricks in a cubic foot?
58. What is the rate of brick in brick work?

59. What is a McAdam road?
60. What is a Telford road?
61. What is a Guidet pavement (New York)?
62. What are the limits of impurities in water for domestic purposes?
63. What area is required, per 1,000 persons, for sewage disposal by irrigation (English standard)?
64. With hemlock at $13 per thousand, what will 100 pieces 2 x 4 x 13 feet long cost?
65. How many miles of sewers in Troy?
66. How many miles of paved streets in Troy?
67. How many miles of unpaved streets in Troy?
68. What is the average daily consumption of water in Troy?
69. If appointed, how much time will you devote to the service of the commission?
70. What was the assessed valuation of Troy last year?
71. What was the tax rate last year?
72. How do the several city departments pay their expenses?
73. What has been the cost of the sewers of Troy?
74. What velocity is required in a sewer in order that it may be self cleansing?
75. What have the pavements of Troy cost?
76. Has there ever been a system of sewers designed for Troy? If so, when and by whom?
77. What is the maximum inclination for streets and sidewalks?
78. Bonds to be issued are to bear what rate of interest?
79. Where are the maps and plans of the commission to be filed?
80. How often must the commission report?
81. What is the official term of the commission?
82. What is the maximum rise of the Hudson river?
83. What sum of money is to be expended during the term of the commission?
84. How many members, or representatives, in Congress?

It is not surprising that one of the distinguished candidates retired in dismay and another was informed he did not pass. It is a very poorly prepared list of questions, but who can answer all the good and reasonable ones?

Reports of State Railroad Commissions.

MAINE.

The last report of the Railroad Commissioners of this State is inferior to that of the previous year in one important particular: the excellent statistical table which accompanied that report as an inset sheet is not found in this, and no attempt whatever is made to summarize the returns of the various railways, except to give the mileage and the summary of accidents. The total extent of railways in the State is given as 1,191 miles, but this includes 11 miles of street roads operated by horses and does not include the Canadian Pacific's new line, so the total mileage at present is about 1,347 miles. The accident record is as follows:

	Passengers.	*Employés.*	*Others.*	*Total.*
Killed	2	9	10	21
Injured	3	12	8	23

The report attempts to keep up with the times by recommending legislation to avoid the construction of new grade crossings and provide for the removal of some of the most dangerous now existing. They also recommend legislation to make obligatory the use of safer methods of heating and lighting passenger cars.

The "official inspection" of the various roads by the Commission is recognized to be somewhat of a farce, for the report says, "It is difficult to determine to what extent the object designated in the law [to secure the safety and convenience of travelers] has been attained by the examinations. If no effort were made by managers of railroads to make them safe and convenient for travelers, it is doubtful if State supervision would alone be sufficient to secure the same." Nevertheless, the Commission affirm their belief that the act providing for an "official inspection" is a wise measure.

NEW HAMPSHIRE.

The chief interest in the report of the Commission in this State centers in the discussion of the "railroad war," which for two years past has been the chief issue in Granite State politics. The report reviews the attitude of the public toward the railways during past years, when "the sole reliance of the public for protection from the extortions, recklessness, and incompetency of railroad officials was in cut-throat competition." In those days consolidation was deemed an evil, and stringent laws were passed prohibiting it. Eventually it was found that this theory of railroad control was wrong and that consolidation was for the benefit of both the railways and the public. The progress of consolidation was checked, however, by the defects in the law passed in 1883, which, as interpreted by the State Supreme Court, prohibited the lease of one road to another except by unanimous vote of the stockholders of the road to be leased; and since that time all has been chaos. The report described at length the deterioration which some of the most important roads of the State, notably the Boston, Concord & Montreal and the Northern Railroad, have suffered, since no one had interest enough in them to keep them in repair, and declares that, in the present condition of affairs, peace at any price is desirable.

In discussing accidents, the report takes strong ground in regard to the fatalities due to trespassing upon the track. It is pointed out that in Massachusetts last year, of 244 fatal accidents, 114 were caused by tresspassing, and but 27 were killed on grade crossings; while during the past ten years the average annual fatality has been: trespassers, 148; grade-crossing accidents, 43. The Commissioners think no legislation in regard to automatic brakes or couplers or steam heating is at present desirable and say that fares and freight rates are lower in New Hampshire than in any other State in which railroad business is done under equal disadvantages.

VERMONT.

This is the first biennial report of the Commission of this State and shows a good deal of hard and faithful work. There is but little statistical matter, however, owing to the failure of some of the companies in the State to make returns, and not to indolence on the part of the Commission. The only statistics given are the following, concerning accidents during the year ending June 30, 1888.

	Passengers.	*Employés.*	*Others.*	*Total.*
Killed	3	13	14	30
Injured	2	20	4	26

The report comments on the large proportion of accidents due to trespassers on the track, and suggests the propriety of legislation making it a misdemeanor, punishable by fine, for a person to be upon a railroad track or bridge. Reports of the investigation of accidents by the Commission occupy 61 pages of the volume; and taking into consideration the fact that the Commission was generally unaided by expert advice and is not made up of railway men, its work in this line is very creditable. The same comment may be made as to the report of the official inspections made by the Commission, which seem to have been conscientiously thorough; and the Board do not hesitate to condemn and criticise where they deem necessary. The bridges, culverts, and station houses seem generally to be very much behind the times. About 50 pages are taken up by petitions, complaints, and decisions and the correspondence regarding them. In every case there seems to have been little difficulty in adjusting the matter complained of as soon as it was brought to the attention of the railroad company.

The total mileage in the State is given at 932.56 miles. There are 124.76 miles of sidings and 8.98 miles of second track. About 350 miles of track is still laid with iron rails.

Grade crossings are briefly discussed, and it is recommended that no new ones be made, and that some provision be made for the removal or protection of dangerous ones now existing.

About no one thing has the Commission so bestirred itself as the matter of steam heating, urged thereto by the White River holocaust on Feb. 5, 1887. The progress made in the introduction of steam heat on Vermont railroads has not been satisfactory, and legislation is recommended making the use of steam heat from the engine obligatory after Nov. 1, 1889. The lack of agreement on a uniform coupler is stated to be the greatest obstacle now delaying the introduction of steam heat, although the expense involved is an important consideration.

In discussing the White river accident, the Commission take strong ground for the use of safer methods of heating and lighting than those now in use, and refer also to the subject of bridge guards, advising "all the railroad companies of the State to take into consideration the most approved methods in vogue anywhere for the better equipment of their bridge approaches where needed, with strong buttresses, flaring safety beams or other practical device to diminish the fatality of this class of accidents." The Commission make this recommendation notwithstanding their expressed belief that "the want of a guard in nowise contributed to this accident"— a statement which we must continue to doubt, but which is of no great importance so long as the above recommendation is carried out.

MASSACHUSETTS.

The report of the Massachusetts Commission was partially reviewed editorially in our issue of March 23, 1889 (p. 263; vol. XXI). Other features of the report, of great interest and value to engineers and railway men, which were not then described, are the special reports on The Deterioration of Pile Structures from the Attacks of the Teredo, by Prof. GEO. F. SWAIN; on The Heating of Cars from Steam by the Locomotive, by Prof. GAETANO LANZA; on German Practice with Regard to Grade Crossings and Track Outside of Stations, by Prof. A. GOERING, of the Royal Polytechnic School in Berlin-Charlottenburg; and on The Prevention of Railway Accidents in Great Britain and Ireland, by E. D. BARBOUR, of London. The carefully prepared report of the Commission's investigation of the grade crossing problem occupies 27 pages. The investigation of the relative safety of steel-tired and cast-iron wheels which followed the Bradford disaster is also of much interest.

The most important petition acted upon was that in which the Old Colony Railroad Company and the North Attleborough & Wrentham Railroad Company each applied for a certificate that public convenience required the construction of a railroad from Adamsdale to Walpole. The board discuss very lucidly the subject of "competing independent lines" and give sound reasons for awarding the certificate to the Old Colony Company.

Taken as a whole, the report is one reflecting great credit on the Commission, and it shows throughout that it is the result of a great deal of careful and conscientious work. The technical matter is of such value that the book forms a valuable addition to the library of any engineer or railway man, something which can be truthfully said of but very few public documents.

RHODE ISLAND.

The report of Commissioner E. L. FREEMAN to the General Assembly is a brief paper, in which, however, some attention is paid to the "questions of the day" in regard to railway management. The State has 257 miles of steam railroads and 67 street railroads, which is, probably, a greater proportion of the latter to the former than could be found in any other State. During 1888 not one passenger was killed on either the steam or street roads. Two passengers were injured on steam roads, however, and three on street roads. The report briefly discusses grade crossings, car heating, and station accommodations. The Commissioner in this State is appointed at the beginning of each year, and has either to omit making any report or else report the doings of a previous year, concerning whose work he is wholly ignorant. It would probably be as well if Rhode Island would leave the companies which cross her territory to the control of the commissioners of Massachusetts and Connecticut, where most of their lines are located; but if she is to have a commissioner at all, his duties should be defined and he should be given the necessary means to perform them rightly.

CONNECTICUT.

The principal interest in this report centers in the action with regard to the removal of grade crossings, which has been about the most important question at issue in the State during the past year. About one-fourth the space in the report proper is devoted to it, and in the appendix the full legal proceedings in the cases of the removal of grade-crossings in the towns of Fairfield and Westbrook occupy nearly 100 pages. The action of the Commission and the several decisions have been frequently referred to in our editorial columns. Another exceedingly important case from a legal point of view is that in which the New Haven & Derby Company sought to make certain changes in the city streets of New Haven for the purpose of improving its terminal facilities at that point. The decision of the Supreme Court was that the railroad company had power to extend its tracks to the very heart of the city, closing highways and streets if necessary for that purpose, provided their acts were approved by the Railroad Commission.

Considerable space is devoted to the car-heating question, but the discussion of the subject cannot be highly commended. Over a page is given up to the bugbear of "scalding steam from broken pipes," which the Commission seem to think may prove a great objection to the use of steam heating. It is not to be wondered at, however, that they were deceived when so many experienced railroad men held the same view. The Commission finally say, however, that they believe steam heating will prove a

success. In regard to automatic couplers, the Commission think all new cars should be equipped with the M. C. B. Standard, and that the Legislature should authorize the Commission to require this. Reference is made to the subject of continuous freight brakes and the belief is expressed that they will come into general use. The statistical tables in the report occupy 40 pages and seem to be well prepared and arranged.

Lesser Railway Structures; Wooden Cattle Guards and Culverts.

We continue herewith by the accompanying large illustrations, Figs. 1 and 2, the series of designs for lesser structures, as used on the Canadian Pacific Railway in its extension across the State of Maine, compiled by E. P. C. GIRONARD, Assistant Engineer. The cattle-guard shown in Fig. 1, both box and pile, is of the type which continues to receive greatest favor. Masonry cattle-guards are rarely durable and effective, and never unless well built of very massive stones, because their size is so small that the tremor of the trains passing over them subjects them to peculiarly destructive strains. Fig. 2 shows a design for a masonry culvert which minimizes these difficulties. Of the two types of wooden cattle-guard, the pile guard is greatly to be preferred, other things being equal, and of course is the only suitable one if a waterway through the guard is essential.

The pile-trestle culvert is not of the type which we should prefer in two respects: We should prefer stringers 30 ft. long, breaking joints and more solidly packed together, with a cast-iron packing washer between them; and we should prefer a split cap rather than a solid one. Our judgment is also that no such openings in the track should be permitted without protecting each end of the structure by Latimer rerailing guards. As to these matters, however, opinions will differ.

The wooden cattle-guard shown in the upper corner of Fig. 2 differs but slightly from that shown in Fig. 1, chiefly in the use of angular cappings for the ties. We believe these are generally very effective. The accompanying design for a masonry culvert is considerably more massive than they are often built, but not a bit too massive if the structure is to stand. Unless water is to be passed through it, there is no real advantage in the masonry guard, since the wooden structure is so small as to be readily watched and renewed.

The lower design in Fig. 2 shows one of the most objectionable kind of wooden structures, viz., an open culvert 10 ft. or more high. The frequent occurrence of such openings in the track is highly dangerous in operating; and in preference to making them, a wooden box culvert, like that shown at the top of Fig. 2, is always to be preferred if it will leave sufficient water-way, the culvert being renewed by an iron pipe drawn through the opening when the wood becomes rotten. Experience shows that in ordinary material the rotten wood may be almost entirely cut away, without the bank caving in for a sufficiently long time to enable an iron pipe to be drawn through and fixed in place.

The Filtering System of the Grand Rapids, Mich., City Water-Works.

The first water supply for Grand Rapids was furnished in 1840 by the Grand Rapids Hydraulic Co., which is still in successful operation. In 1873-75 the city built works, taking the supply from Carrier creek, and later drawing upon Cold brook, and finally upon Grand river. The supply from Grand river passes through two filter beds, and a third is now being constructed. The first bed was but 14 by 16 ft., the second, 12 by 110, and the new one will be 40 by 480 ft.

The new filter bed is a little to one side of the center of the river, and is expected to furnish a daily supply of from 8,000,000 to 10,000,000 galls., free from sediment and reasonably clear. The bottom of the filter bed will be 5 ft. lower than the bottom of the river. There will be 3 collecting galleries, parallel with each other, about 10 ft. apart, and converging to a conductor 3 by 3 ft., connecting with the old filters and the pump well. The collecting galleries will be about 2 ft. wide by 2 ft. 8 ins. deep.

The sides of the galleries will consist of 1 x 6 in. boards, laid flat, with wooden strips between them, each 2 ins. wide by 1½ ins. thick, laid 1 in. apart. The galleries will be covered by two thicknesses of plank, laid lengthwise on 2 x 6 cross-pieces 8 ins. apart. There will be about 3 ft. of filtering material above the galleries; from the top down this material will be 6 ins. of coarse sand and successive 6-in. layers of graded gravel. The space between the galleries will be filled with broken stone.

Most of the excavation in the river bed is through limestone. The contract has been let to A. C. SEKELL for $11,979. The Designing Engineer is FREEMAN GODFREY.

Some objections to the design of the filter have been made on the ground that it cannot be successfully washed, and that thus after a short time it will be nearly useless. The general construction of the other filter beds is not given, and though it seems that they have worked satisfactorily, the larger of the two has been in operation only about a year. It is stated that Mr. GODFREY proposes to clean the new filter bed by forcing water through two pipes to two points, depending upon the spread of the water through the under surface and its rise to the top to carry up to the current of the stream the sediment that had been deposited. There is certainly reason for questioning the success of this method of washing; for, even with some provision for spreading the stream at the mouth of the pipes, the water under pressure would certainly rise to the surface, spreading over but a small area. As the total area of the filter bed is 19,200 sq. ft., each stream under pressure will have an area of 9,600 sq. ft. to wash, and the water must extend sidewise for 20, and lengthways for 120 ft. However, it would be a very simple matter to lay a pipe through the center of the bed, and extend laterals, and, if necessary, branches each way from these, so that the whole area might be thoroughly washed.

To pass 10,000,000 galls. in 24 hours, the average flow would be about 550 galls. for 1 sq. ft.; and while this may be sufficient to remove the larger particles in suspension, it could do little or no more.

For the details regarding the filter we are indebted to FRED. TWAMLEY, Secretary of the water-works, and to the Grand Rapids *Eagle*. It should be remembered that the city is not wholly dependent upon its own works for a supply, the Hydraulic Co. having a system including about 20 miles of mains and 1,000 taps.

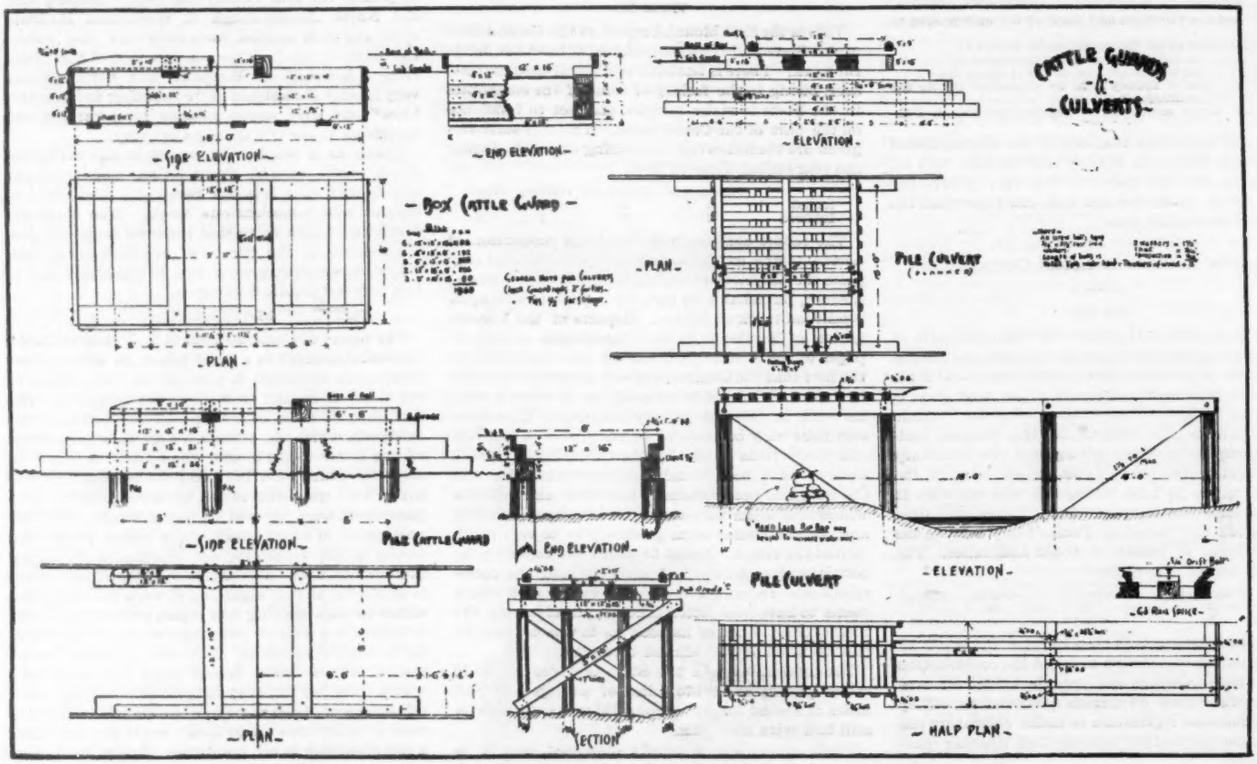


Fig. 1. Lesser Railway Structures: Wooden Cattle Guards and Culverts.

A party of 250 American engineers are traveling in Europe. So many representatives of engineering, which is responsible for the Johnstown dam, will naturally excite considerable interest and curiosity in Europe at this time.—Chicago *Herald*.

In the words of the immortal J. BILLINGS, it is better not to know so many things than to know so many things that are not so.

War Ship Design in England.

[From a London Correspondent].

If we in England may judge by what we see in American papers, "the state of the navy" is becoming in the United States a popular question, and Americans are no longer content to remain with the chance of a petty State in the southern halt of the hemisphere ravaging their coast because that State happens to possess an iron-clad or two. Americans have, it seems to us here, been in times past inclined to place too much reliance in torpedo defence. In England we fell into the same mistake in common with most other naval powers of Europe. We, however, always recognized that the torpedo could only play a subordinate part in a scheme of coast defense, but we now find even the part assigned to it was more than it could be expected to fulfil. Our naval manœuvres, coupled with recent experiments on an obsolete ironclad, the *Resistance*, have opened our eyes to this fact.

The state of the navy is a problem always with us in Great Britain. Although England's fleet is her chief pride and glory, no one ever seems quite satisfied with it. Certainly naval officers are not; they say it is too small, and a great many of them say the ships we have are not of the right sort. The naval constructors who hold official positions in government service are precluded from venting their opinions in public, but it is a pretty open secret that they have not altogether approved of some of the modern types of battle ships. But the most discontented man of all is Sir EDWARD REED, the sometime director of naval construction to the British Admiralty. In order to make plain how this question of war-ship design stands in this country, it will be necessary to say a few words as to the manner in which naval administration is conducted.

Her Britannic Majesty's Navy is governed by a board appointed by Parliamentary influence. It consists of a parliamentarian, pure and simple man. Every time there is a change of ministry, there is a fresh First Lord of the Admiralty. Were the Government overthrown in Parliament to-morrow, say on the matter of a farthing a pot tax on small beer, or any other burning question, the whole Admiralty office would be turned upside down, and before a week was over, there would be a new ruler of the Queen's Navy. With the First Lord would go, his Parliamentary colleagues and probably very soon after, if not at the time, the Naval Lords as well. It is a case of "The spoils to the victors," a phrase which the writer believes has been heard in connection with the political procedure of an other nation.

Thus the Board of Admiralty, like many other departments of the State, is in a pretty constant state of change; and this is one of the great drawbacks of our cherished Parliamentary system. It would not matter so much if the great political parties, Liberal and Conservative, had each a stock member who was always destined to take the office of First Lord

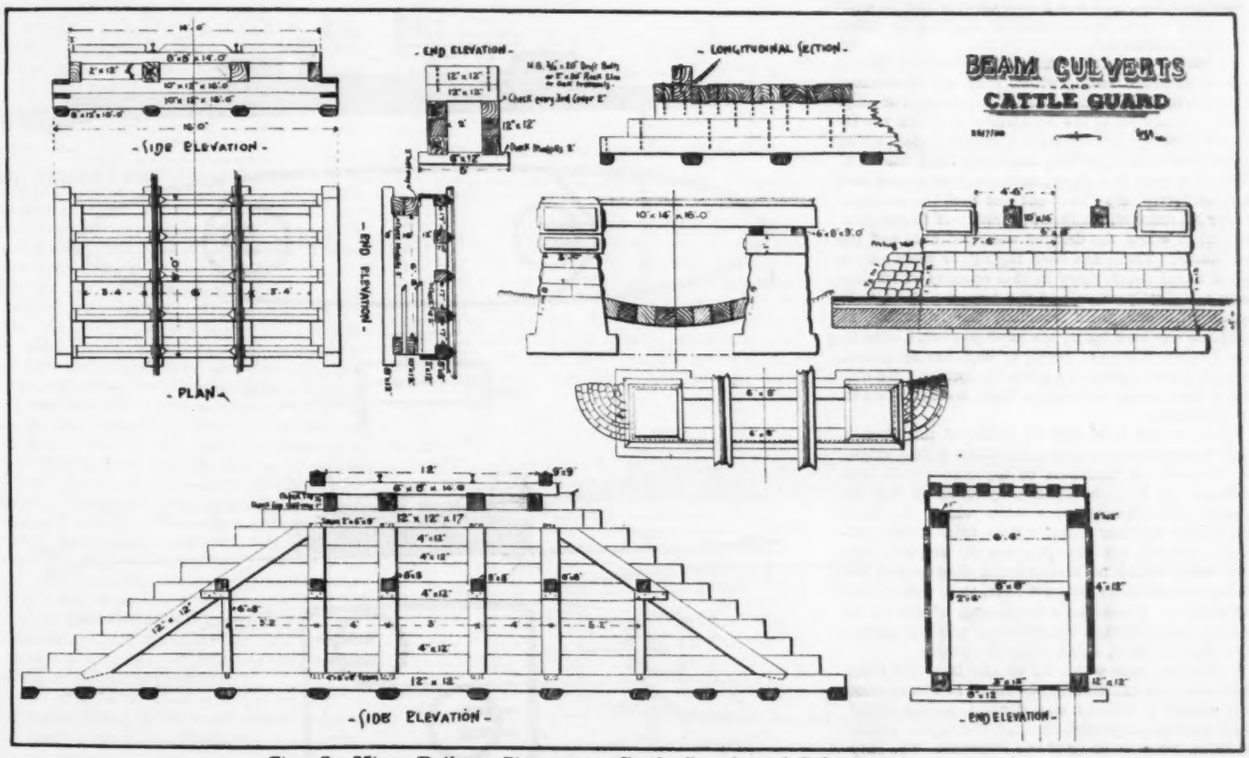


Fig. 2. Minor Railway Structures: Cattle Guards and Culverts.

The building of the fine war ships that have been recently added to the United States Navy prove America to be in earnest about the reconstruction of her fleet; and the wise policy of producing all war material at home is another sign of the times, which we in England fully recognize, however gladly we would have built the ships, perhaps at a less price than they could have been constructed elsewhere.

The United States have not yet, the writer believes, considered to any great extent the building of what we call "battle ships," that is, first-class ships of the line. To be a first-class naval power such ships must, however, be possessed by a nation, and it is therefore to this branch of naval construction that Americans must sooner or later turn their attention if they wish to see their country occupy that honorable position; and it is to this end, therefore, that the American public must turn their thoughts if the present policy is to be carried to its legitimate conclusion. Such at least is the opinion of the best naval authorities in Great Britain, in spite of torpedoes, high explosives, dynamite shells, submarine boats, and many other more or less fanciful adjuncts of naval warfare. The sea is always kindest to the biggest ships. Under these circumstances, our experience on this side of the Atlantic can hardly fail to be of interest to Americans, and no apology is needed for the following remarks.

We, in England, place a good deal of confidence—at least a great many of us do—in this autocratic form of ruling great departments of the State. We say it is better to get a good man and give him his own way, rather than have divided counsels and chaos. Unhappily, in the case of the Admiralty, we do not go the right way to work to get the good who has the title of First Lord of the Admiralty. He is the supreme chief, and gets £4,500 a year, and a handsome residence as well. We then have four Naval Lords, generally admirals, who are selected on account of their supposed fitness for the duties to be undertaken, although political considerations largely govern their appointment also. These naval officers may be looked on as little more than technical advisers of the First Lord, as he can overrule the decisions of the whole Board—is in fact autocrat in his own department. It is of course open to any of the Board to express disapprobation by resignation, but such a step is not often taken, and generally leads to very little when it is. The two remaining members are a Civil Lord, a sort of "handy-man" to the Board, and a First Secretary, who is, to the First Lord, very much what the little pig was to St. Bartholomew. It will be seen, then, that our navy is subject to the will of a single individual, responsible only to Parliament and country; which means, of course, that he is not responsible at all. We never impeach our cabinet ministers now.

But, it may be said, "there are permanent officials." That is true, and the chief of these are the Permanent Secretary and the Director of Naval Construction. The former is not a sailor, not a naval architect, engineer, or anything else that has especially to do with the sea. He is simply a glorified government clerk, and in him are centered all the red tape forms and ceremonies which are so dear to the average British official. He is the servant of the Board, and if he were to attempt to talk about things he did not understand—say ships or guns—of the Admiralty. Then there might be a chance of these men learning their business, and a fairly continuous policy might follow. But this is by no means the case. These important government posts are to be reached only by party services. A man serves his party well, votes straight, as it is called, and is a strong man in "the House," and so struggles upward to a berth. It will be obvious that new men will not get the highest posts, but as they prove their influence and importance, so will promotion come. Now the First Lordship of the Admiralty is not a very exalted position in the Cabinet, and, therefore, as those who fill it grow in power, they pass on to other spheres. For this reason, it is not often that we get the same man in twice—the present First Lord being an exception—and we are consequently having appointed, with great frequency, men who hardly knows one end of a ship from the other.

he would be pretty severely snubbed by his masters. To give him his due, he never attempts such a thing. The Director of Naval Construction is quite a different kind of man. He is a trained scientist, educated especially for his post, which he can only hope to reach by long competition, for the appointment does not go by saniority. Our present Director of Naval Construciion, Mr. W. H. WHITE, is a man of exceptional natural ability, which has been disciplined by close study and a wide experience. What is more, he is a man who knows what he wants, knows how to ask for it, and, mostly, how to get it. Altogether he is a strong man. He gets £2,000 a year, and could make at least h were he to leave the Government; but he has a laudable ambition to be chief of the service in which he has been trained, and this he esteems beyond riches.

Yet this man is but a servant in the office of the Third Naval Lord, and nominally can no more settle the design of a war ship than can one of his own draughtsmen. He is, of course, responsible for calculations, etc., just as a government writer at eight pe ce an hour is responsible for copying his letters without mistake.

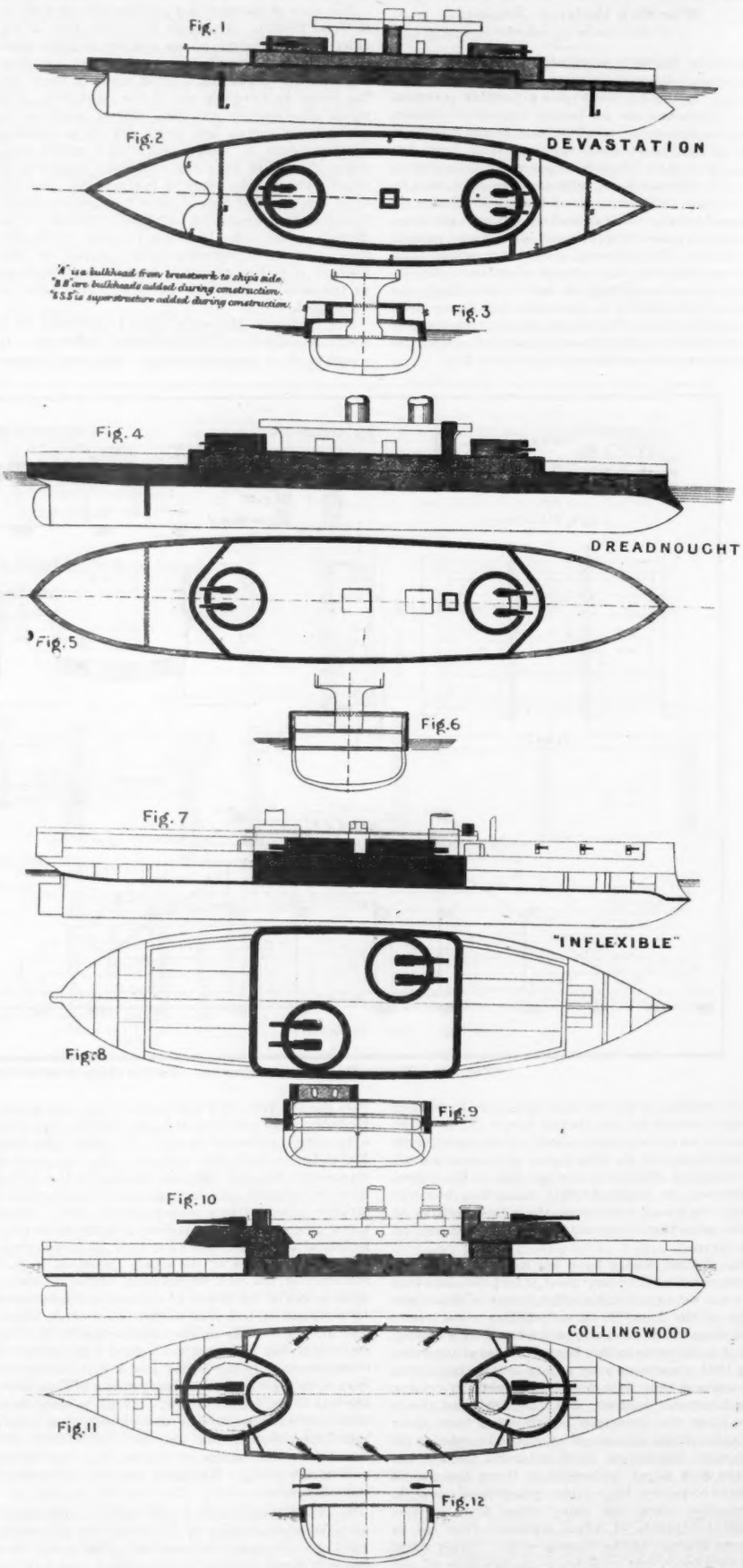
It will be seen from this brief sketch of British naval administration, which may not be without interest to American readers, that designs of ships may be produced at the Admiralty of which the Director of Naval Construction, personally, does not approve; and such, indeed, has lately been the case. The *Nile* and *Trafalgar*, our two most recent and largest battle ships, have not met with the approval of Sir NATHANIEL BARNABY (Director of Naval Construction when the designs were got out) and his assistants. There has been raging for years past a great naval controversy in this country which has been called "The Battle of the Armored Ends." It began with our great ironclad, the *Inflexible*, at the time she was built, the most powerful ship in the British Navy—at least, so said her designers, but there were others of a different opinion. To elucidate this point, we must go back a step or two in naval history.

When in the year 1859 we followed the French in protecting with armor a first-class battle ship—the *Warrior*—a thickness of 4½ ins. of iron was sufficient to keep out the projectiles of the 68-pounder smooth-bore guns with which we then armed our fighting ships. This thin armor sufficed, however, for the purpose of keeping out shell, and it must be remembered that it was for protection against shell, not shot, that armor was first devised. It enabled a large area of side to be covered, and although the *Warrior* was not plated from stem to stern, subsequent ships were.

Artillerists soon woke up to the fact that their guns were not sufficiently powerful, and it was not long before a weapon was devised which would easily send its projectiles through the 4½-in. armor and 18-in. wood backing of the *Warrior*. The only thing remaining for the ship designers was to increase the thickness of the armor, and this movement was answered again by the artillerists making bigger guns. So matters went on, step by step, until in 1869 the *Devastation* was built. She had n place of the numerous broadside armament, only four guns, but these were 38 tons each and were placed in two turrets. The iron armor, as ma be seen by our diagrams Figs 1, 2, and 3,* extended from stem to stern post, excepting a part of the superstructure. It was 10 ins. to 12 ins. thick amidships, and 8 ins. forward and aft. Even this, as it then seemed, enormous thickness of plating was not proof against the ever-increasing guns. A subsequent vessel, the *Dreadnought* (see Figs. 4, 5, and 6) had her maximum thickness of armor still further increased to 14 ins., the plating being carried the whole length of the ship. This vessel marks an epoch, and was the last armorclad designed while Sir EDWARD REED was Director of Naval Construction. She was originally named the *Fury* and her general arrangement was much altered when Sir NATHANIEL BARNABY succeeded Sir EDWARD REED.

The next battle ship we will mention is the *Inflexible*, already referred to; and with her may be said to have commenced the Battle of the Armored Ends. Sir NATHANIEL BARNABY had suc-

* For these and the following diagrams we are indebted to a paper by Mr. W. H. WHITE, the Director of Naval Construction.



Figs. 1 to 12. Types of British Line-of-Battle Ships.

ceeded Sir EDWARD REED as Director of Naval Construction, and the new constructor soon found that armor must go on increasing in thickness if it was to keep out the projectiles of the still growing guns.

Perhaps it is well to explain here, in reference to what has been said about the Director of Naval Construction being subordinate to the Board of Admiralty, that such has always been nominally the case. Sir EDWARD REED, then Mr. REED, however, came to the Whitehall under quite exceptional circumstances. It was felt then that the science of designing war ships was so changing in its character, in consequence of the introduction of steam and armor, that the old mast and sails admirals, who had been brought up in our "wooden hulls," were not fit to decide on the form the new ships should take. Sir EDWARD REED, who had received a scientific education in the Government Schools for Naval Architecture, was therefore called in, and the Board of Admiralty were willing to look on him as their oracle. Unfortunately the arrangement did not work quite as smoothly as might have been wished. Whether ISSACHAR waxed fat and kicked or whether their lordships were incorrigibly stupid, overbearing, and obstructive, boots us not to inquire. At any rate, the Director of Naval Construction resigned, and ever since has proved a bitter and relentless critic to future admiralty war ship designs.

Sir EDWARD was succeeded, as we have said, by Sir NATHANIEL, then Mr. BARNABY. The new Director was a man of different stamp to his predecessor, but they were alike in this, that they were both men of strong will and of a character able to lead. Sir NATHANIEL BARNABY is a born designer. His heart and soul are centered in scheming plans and details of construction. With him it was no academical question what armor should be carried or what guns should be mounted. The ships he designed were as his own flesh and blood, children of his brain and creations of his intellect. So long as such a man was left to play a leading part, or so long as he was in harmony with his colleagues, he worked *con amore* and held his office with pride and satisfaction. But to the old school of sailing admirals, the direct descendents of BENBOW and NELSON, succeeded in time on the Board, men of quite a different type. These had gained a great part of their sea experience in armored steamers, and they had ideas on the subject. These ideas by no means coincided with those of the naval architects. For some time there was friction, then an open rupture, and at last Sir NATHANIEL BARNABY left Whitehall, retiring on a pension, full of years and honors, but with the possibility of much good work then and now still before him.

After this digression we may return to the *Inflexible*, illustrations of which vessel will be found in Figs. 7, 8, and 9. Sir NATHANIEL found it necessary to place on her sides armor as massive as 24 ins. thick in some parts, and 20 to 16 ins. in other parts. Now as this ship carries over 80-ton guns, it is evident that she must be either very much bigger than the *Dreadnought* or her armor must be much more restricted in area, unless the *Dreadnought* has a great surplus of buoyancy. The latter, however, was by no means the case, for the *Devastation*, *Thunderer*, and *Dreadnought* were all comparatively low-sided ships and carried neither masts nor sails, except a small "military mast" for signal and look-out purposes; so there was very little to come and go upon in the matter of displacement. The *Inflexible* was somewhat bigger than the *Dreadnought*, the former being 11,880 tons and the latter 10,820 tons displacement. The difference in size would not, of course, be anything approaching that necessary to allow of the additional thickness of armor being carried, supposing the area of surface covered to be the same. It should also be remembered that the main armament of the *Dreadnought* was four 38-ton guns, while the *Inflexible* carried four 80-ton guns, to which must be added the increased weight of ammunition for one larger gun, by no means an inconsiderable trifle; thus the weight of the *Dreadnought's* projectile is 820 lbs., while that of the *Inflexible* is 1,700.

As a matter of fact, the weight of armor in each ship is very nearly the same, being 3,260 tons in the former and 3,280 tons in the latter. This evidently means a decreased area of protection; thus while the *Dreadnought* has her whole 320 ft. of side, except the superstructure forward and aft, protected by armor, the *Inflexible* has but 110 ft. of vertical armor placed amidships. Associated with this vertical outside armor, there is, in the *Inflexible*, a strong protective steel deck built across the ship a few feet under water. We have thus a vessel carrying vertical protection only in her central part, where the "vitals" of the ship are situated, and horizontal armor, i. e., the deck, at the ends. Our illustrations will give a sufficient idea of the arrangement.

in commission. Figs. 13, 14, and 15 show the disposition of armor, and here it will be seen we have a return toward the *Dreadnought* system, with this important difference, that there are unarmored ends, so far at least as vertical armor is concerned. It will be convenient here to throw the chief elements of design of the most important vessels we have mentioned into the form of a table, adding particulars of the *Benbow*, another of the Admiral Class. For these particulars we are indebted to Mr. W. H. WHITE the Director of Naval Construction.

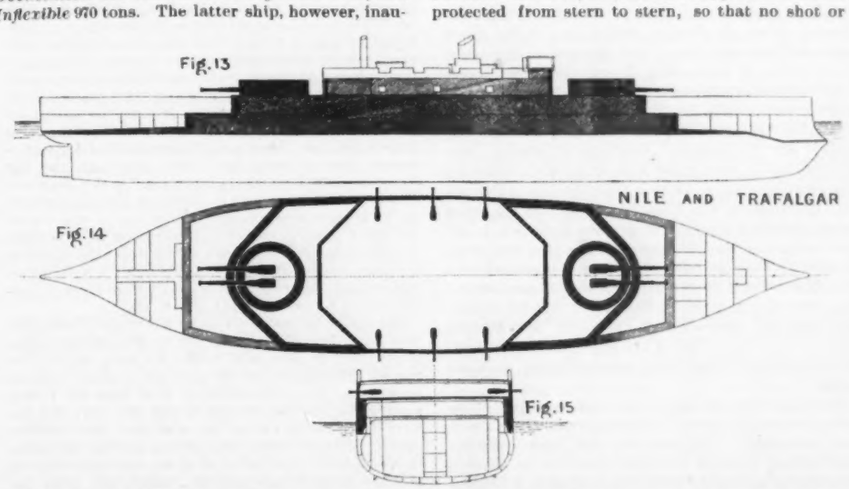
	Warrior.	Dreadnought.	Inflexible.	Collingwood	Benbow.	Trafalgar.
Date of design	1859	1872	1874	1880	1882	1885
Length in feet	380	320	320	325	330	345
Breadth in feet	58' 3"	63' 10"	75	68	68' 6"	73
Load displacement on first commission, or as designed in tons	8,830	10,820	11,880	9,150	*a*10,000	*b*11,940
I. H. P.	5,500	8,000	8,000	9,000	11,500	*b*12,000
Speed in knots at load displacement	14.4	14.2	13.7	16.7	17	*b*16.5
Number of guns	40	4	4	10	12	12
Heaviest gun	110 lbs.	38 tons.	80 tons.	45 tons.	110.5 tons.	67 tons.
Calibre of guns in inches	7"	12" 5"	16"	12"	16 25	13.5"
Powder charge in lbs	12	130	450	315	900	520
Weight of projectile in lbs	110	820	1,700	714	1,800	1,250
Total weight of armor in tons	980	3,260	3,280	2,520	2,900	4,230
Weight of horizontal armor	nil	680	970	905	1,155	1,040
Greatest thickness of side armor in inches	4.5	14	24	18	18	20
Ratio Total weight of armor displacement.	.111	.296	.272	.275	.290	.352

a. The displacement is 10,600 tons with the full complement of 1,200 tons of coal on board. The figures given in the table are for 600 tons of coal.

b. The *Trafalgar* has not yet been tried. Probably the I. H. P. and perhaps also the speed will be in excess of the estimate here given.

These are the broad characteristics of the two types of vessels, but it must not be thought that the *Inflexible* was the first ship to have horizontal armor, for in the *Devastation* and *Dreadnought* there was a good part of the protective plating devoted to this purpose. The respective weights of horizontal armor in deck, glacés, plates, etc., are: *Devastation* 560 tons, *Dreadnought* 680 tons, and *Inflexible* 970 tons. The latter ship, however, inaugurates a new class in consequence of her restricted arc of armored side and her ends being quite unprotected by vertical plating.

It is around the designs of the last five ships and those of the new vessels in this year's programme, which we shall deal with later on, that the Battle of the Armored Ends rages. The oldest ship, the *Dreadnought*, which, by an important section of naval officers, is considered "the most efficient fighting ship of the day" (the words quoted are those of our first Sea Lord, Admiral HOOD) presents a side protected from stern to stern, so that no shot or shell could strike her without meeting with the resistance of armor. She has a long armored citadel, 144 ft. 4 in. in length amidships and her turrets are placed well apart so that the armament is not too concentrated. Quick firing and machine guns have been added within the last two years. Compared to her, the *Inflexible*, with her comparatively small patch of armor amidships, and her long, unprotected ends would appear at first glance a very weak fighting ship. The speed of the larger and more modern vessel is also less, but her armament is far heavier. The great advantage of the *Inflexible* is of course her increased thickness of armor, and it is in this feature that the chief point of the controversy centered, when the design was so much criticized some years ago. The admirers of the *Inflexible* said: "You have gone on increasing the power of your guns until we cannot clothe our ships from stern to stern with armor thick enough to keep out the projectiles. If a shot or shell is going to fairly pierce the side of a vessel, armor is a disadvantage: the ship had better be unarmored, and the projectile allowed easy ingress, and egress on the other side. Under these circumstances we do the



Figs. 13, 14, 15. The "Nile" and "Trafalgar"; The Latest Type of Line-of-Battle Ships.

We now pass to a still further development of the concentration of vertical protection system,—the much criticized "Admiral" class. In these ships the high-water mark (Sir EDWARD REED would say "low-water mark") of the principle was reached, and since then we have seen a reflux movement. In Figs. 10, 11, and 12 are given three views of the *Collingwood*, one of the Admiral class. The greatest thickness of side armor is 18 ins., a great reduction, it will be seen, upon that of the *Inflexible*. This was rendered possible by the introduction of compound armor in which a hard steel face is associated with a softer but more fibrous backing of wrought iron,—an attempt to combine the shot-resisting powers of both materials. In the Admiral class the external vertical armor, it will be seen, is reduced to a water-line belt of short length in the midship part.

We will now pass to the most recent type of battle ship yet constructed. This consists of two vessels, the *Trafalgar* and *Nile*, neither of which is yet

best we can, and put real protection over the vital parts of our vessel, leaving the less important ends to take their chance. In order, however, to make this chance as good a one as possible, we minutely subdivide into water-tight compartments and fill spaces with stuffing of cork, etc. It must also be remembered that the form of the ship tapers towards the ends, etc.: therefore, even if a section of the hull be opened to the sea from side to side, it is not of so much consequence near the bow or stern as it is amidships The armored deck also must not be forgotten. Finally, war is always a dangerous game: no ship can be built that will be absolutely impervious to attack, warship design must always be a matter of compromise, it is a game of chances, and we offer a vessel we think the best compromise for obtaining the greatest number of chances."

The other side will say: "Certainly, war is a game of chances, but our complaint is that you have not properly balanced the chances. With the machine and quick firing guns of the present day, the chances are far more in favor of a *Dreadnought* knocking the stuffing out of your ends by her light, quick-firing armament, than of you reaching her vitals by piercing her armor with your heavy guns. These big guns fire slowly, the ammunition is so heavy that you can only carry a limited supply. A ship in any ordinary weather offers such an unstable platform that the firing must be uncertain, and, moreover, your data as to the armor-piercing qualities of your heavy guns is based on target experiments in which the projectile strikes the plate at right angles: in real war the greater number of hits would be more or less glancing shots, and under those conditions comparatively thin armor may effectively resist very heavy blows."

Such are the main points that advocates of the rival systems might be supposed to raise. It is necessary they should be stated in order that the respective merits of later ships may be duly appreciated.

With regard to the *Benbow* and *Trafalgar*, the former being, as already stated, one of the much abused "Admiral type," and the latter our latest built design of battle ship, it is a pretty open secret that the present Director of Naval Construction is mainly responsible for the professional work in the "Admiral" designs; for, although they were got out under Sir NATHANIEL BARNABY'S régime, Mr. WHITE had a very great deal to do with planning the arrangement. At that time the late Admiral, Sir COOPER KEY, was First Sea Lord. On the other hand, Admiral HOOD, the present first Sea Lord, has taken the responsibility of the *Nile* and *Trafalgar*, two ships with which all the chief professional officers of the construction department—then Sir NATHANIEL BARNABY, Mr. BARNES, and Mr. MORGAN, expressed disapproval. Mr. WHITE at that time was chief of the ship-building department at ARMSTRONG'S vast establishment at Newcastle.

Having so far given a brief and necessarily imperfect sketch of ships that have already been built and launched in England, we will later consider new designs brought forward this year by British Admiralty, and about which so animated a controversy is raging at the time these notes are being written.

(TO BE CONTINUED.)

BOOK REVIEWS.

Practical Blacksmithing. Compiled and edited by M. T. RICHARDSON, editor of *The Blacksmith and Wheelwright.* New York, M. T. Richardson, Publisher. 8vo, pp. 224; illustrated. Price $1.00.

This very practical work is compiled from a series of articles on this subject contributed to the journal of which Mr. RICHARDSON is the editor. The book itself is curious inasmuch as it is said to be the first publication on this subject in English. It is excellently illustrated with all manner of tools and methods of applying them, many of them very ingenious, and interesting even to the novice in blacksmithing. It is a book of a useful, practical class that can be heartily recommended as worth many times its price to any one interested in the subject of which it treats.

State of Rhode Island and Providence Plantations. Annual Report of the Commissioners of Dams and Reservoirs. January, 1883, Do., 1884, 1885, 1886, 1887, 1888, 1889. Pamphlets.

Commissioner L. M. E. STONE has so efficiently performed his work that he has been retained in office ever since his appointment, immediately after the passage of the act providing for the inspection and supervision of the dams and reservoirs within the State. It is fortunate that the same act that created his office required that the Commissioner should present to the Governor each January a report of the work done the preceding year, for the reports for the years 1882-88, inclusive, give the results of the examination of every dam and reservoir in Rhode Island up to Jan. 1, 1889, a total of 434. There are also many plates in the reports for the last six years, giving sectional and other drawings of the most notable dams, whether notable or their merits or for their faults.

During the first two years of his work, Mr. STONE made a preliminary examination, and reported upon the 415 dams and reservoirs then under his jurisdiction. Thus the location of every dam was determined and recorded, together with its dimensions, form, material, capacity, the existence and actions of any leaks, and the damage which might result if the structure should give way. The distribution of the dams by counties then was:

Providence	253
Kent	75
Bristol	1
Newport	8
Washington	78
Total,	415

As will be seen, Providence Co. had more than half of the dams and reservoirs in the State, 253, there having been in one of its towns, Scituate, 38. The seaport counties, Bristol and Newport together, had but 9, and of these Bristol Co. had but 1.

After each dam and reservoir within the State had been inspected and a description of it recorded, good judgment and quick action might easily follow upon any application to the Commissioner for his services, while he has ever since known the status of the weakest dams, so that at short notice extra precautions for their safety could be taken, if necessary, and a continual effort made to raise all to a high standard of safety.

The preliminary inspection being completed, there was afterwards time for a more detailed examination of dams needing especial attention. Beginning with his third report, Commissioner STONE has now published 236 plates, giving sectional and other drawings of at least 100 dams, with explanatory or supplementary text. Many of these drawings illustrate dams with commendable features, and others with objectionable ones, while several show types of dams no longer, or seldom, followed. Among the most notable of the dams illustrated are those recently constructed for water-works, and of these the most important, and the "largest of the kind within the State," is the Diamond Hill Reservoir dam, built in 1885-87 in connection with the Pawtucket water-works. There are in the report for 1886, 9 pages given to the illustration of this dam, 2 pages being reproductions of photographs showing the work under process of construction. A description and several illustrations of this dam were given in ENGINEERING NEWS for June 1, 1889, p. 493.

The report for 1886 contains a table giving the annual rainfall at Providence from 1832 to 1886, inclusive, and the rainfall by days, with totals for each month, for 1885-86. The reports for 1887 and 1888 give the rainfall by months. It is interesting to note that the lowest annual rainfall since 1832 was in 1846, 30.51 ins., and the next to the lowest was in 1835, 30.96 ins. The highest annual rainfall during this period was in 1888, when the remarkably high fall of 63.44 ins. was recorded. In 1878 the rainfall was 59.32 ins., which had been the highest since 1863, when the fall was 53.52 ins. The average annual rainfall at Providence for the last 59 years has been 43.55 ins.

During the first four years covered by the reports, the rainfall was not heavy, and it was so distributed through the several years that the water in the reservoirs was quite low. This gave an opportunity for a closer examination of the several dams than would have been possible had they been full, but there was little or no chance to study their action and efficiency when the ponds were full. In February, 1886, there fell 11.31 ins. of rain, 8.13 ins. on Feb. 13, a greater amount in this one day than the total rainfall of any other month during 1885-6-8. The ground was covered with a heavy body of snow, the melting of which made an estimated additional 4 ins. of water. As the ground was frozen, all of the water made its way to the streams, overflowing them in an unprecedented manner. Many railways and flood-gates were far too small to carry the flood, and often the whole top of a dam became a roll-way. There were a very large number of failures, but most of these resulted from the overflow rather than from the pressure, only a few timber dams giving away from pressure. Many earthen dams were saved only by the frozen condition of their embankments, which prevented them from being gradually washed away, and also made a compact mass to withstand the pressure, and bound them closely to the natural surface. In commenting upon the effects of the flood Commissioner STONE urges that permanent structures should be built of imperishable material, and elsewhere in his reports he says that an excess of material is quite generally substituted for thorough workmanship, and that the material is often wrongly placed, so that the most bulky dams often require the greatest amount of attention.

Much could be cited from these reports regarding the dams described and illustrated, and we hope to do so at another time. The general scope of the Commissioner's work has been given, and we sincerely hope that the engineering profession throughout the country will realize how commendable, yes, imperative, is just such supervision of dams and reservoirs as Rhode Island provided for and has secured.

Elsewhere in this issue we discuss the subject more fully under the heading, State Supervision of Dams and Reservoirs in Massachusetts, Rhode Island, and Connecticut." The statute under which the Rhode Island Commissioner acts is given in full in his report for 1883. It is Chapter 271 of the Public Laws.

The Technic; the Annual for 1889 of the Engineering Society of the University of Michigan. Ann Arbor, Mich. Price, 50 cts.

CONTENTS:—Sketch and Portrait of Prof. M. E. COOLEY—Recent Endurance Test of Metals, C. A. MARSHALL.—An Electric Mining Hoist, F. G. BULKLEY—Bending Moment on Pins, Prof. CHAS. A. GREENE.—A First Class Passenger Coach, R. P. LAMONT.—Natural Gas, P. R. WHITMAN.—Some Injector Tests, E. B. PERRY.—Overhaul, G. M. WALKER.—Stand Pipe, vs. Trestle Tower, H. S. CROCKER,—Miscellaneous Notes, etc. This annual is a very creditable production in matter contained and in its general appearance.

Engineer's Hourly Log-Book, arranged to record for each hour of the twenty-four totals and averages of boiler pressure, fuel fired, ashes and unconsumed combustibles, uptake temperatures, feed temperatures, turns per minute, etc. etc. By ROBT. GRIMSHAW, M. E. Practical Publishing Co., 21 Park Row, New York. Price 50 cts. postpaid.

This appears to be one of these handy, labor-saving productions that require no other commendation than use.

PUBLICATIONS RECEIVED.

—*Wood Vulcanizing.* Small pamphlet, pp. 16.

This tasteful little pamphlet, from which we make some extracts in another column, is issued by the company controlling the process, at 40 Wall St., New York.

—*Annual Report on Improvement of Certain Harbors in Massachusetts, Connecticut, and New York*, in charge of Lieut.-Col. WALTER MCFARLAND, U. S. Engrs.

—*Canal de Nicaragua: Exposition Universelle de Paris*, 1889.

This very neat pamphlet gives in English, French, and German a brief account of the enterprise and some neat maps and views. Those interested in the project will do well to obtain a copy.

—*Closets.* An illustrated catalogue of closets, published by James B. Clow & Son, manufacturers of and dealers in plumbing supplies, Lake and Franklin Sts., Chicago, Ill Bound in cloth, 54 pp., 9 x 12 ins.

—*Prospectus of the Corpus Christi & Padre Island Harbor Co.*, of Texas, Hon. JOHN WILLETT, Projector: A. BONZANO, L. M. HAUPT, Consulting Engineers. San Antonio, Tex.

A pamphlet of 41 pages, advocating the construction of an exterior harbor at Corpus Christi, Tex., by the construction of a rip-rap and concrete pier, to afford 25 to 30 ft. of water, at a cost of $2,000,000. It is noted that there is no port between New Orleans and Vera Cruz with over 14 ft. of water, and that the tide rises only 14 ins.

AMERICAN STEEL shows up well in the late accident to the U. S. Cruiser *Boston*, as this vessel now lies on the dry dock. Eight of the injured plates will have to be removed; and as each plate is 14 x 4 ft., the area to be repaired equals over 400 sq. ft. The injured plates are bent and twisted without fracture to a degree that bears loud testimony to the excellent quality of the material put into them six years ago by an American steel maker.

SOCIETY PROCEEDINGS.

Denver Society of Civil Engineers and Architects.—The regular monthly meeting was held Aug. 13; Pres. NETTLETON in the chair, 20 members present. JAS. PHILIPS MAXWELL, of Boulder, now State Engineer, and JOHN WELLINGTON NESMITH, Pres. of Colorado Iron Works, were elected members. A communication from the Chairman of Committee of the American Society of Civil Engineers asking that a committee be appointed from the Society to confer with them to see if arrangements could be made for an affiliation between the societies, was received and a committee

appointed consisting of Prof. P. H. VAN DIEST, Chairman, with Mr. H. L. AULLS and ROBT. S. ROCHLAMB.

A committee of five, consisting of JAS. R. MAXWELL, Chairman, and J. S. GREEN, WALTER H. GRAVES, R. D. HOBART, J. C. ULEICH, were appointed to act with other committee of the State in collecting statistics and waiting upon the U. S. Senate Committee on Irrigation of the Arid Districts, which will meet in Denver about Sept. 15.

Prof. P. H. VAN DIEST read a paper on "Mining in the Island of Sumatra by the Dutch Two Hundred and Fifty Years Ago." The mining was done in the same manner as at present. The maps were quite ingenious, and illustrated all the country, showing sections and elevations together. The stockholders manipulated the stock a good deal as at present. The mines were very rich, as only $600 ore was allowed to be shipped. A new company has recently been started, and will reopen the mines, which have not been worked for over one hundred years.

GEO. H. ANGELL,
Sec. pro tem.

New England Roadmasters' Association.—*Annual Convention.*—The Seventh Annual Convention was called to order at the American House, Boston, Mass., at 2.30 P. M., Aug. 21, by the President, J. R. PATCH (Conn. River R. R.), who made a brief address, congratulating the members on the prosperous condition of the Association. The conventions grow each year in importance and interest to their members and in the benefit derived by the railroad companies represented.

The President read a notice inviting all members of the Association to attend the annual convention at Denver of the American Roadmasters' Association. For the accommodation of those wishing to attend, a special car will leave New York City Sept. 4.

The minutes of the last meeting and the secretary's report were read. The attendance at the last annual convention was greater than at any previous meeting, except that at a former annual convention in Boston. The receipts during the past year have exceeded the expenses by $69.47. During the past year, the Association lost one of its most enthusiastic and useful members, Mr. L. H. PERKINS, of the New York, New Haven & Hartford railway. Mr. E. NEWCOMB, of the Portland & Ogdensburg, the present chaplain of the Association, has retired from active service as a roadmaster. The Treasurer's report showed a balance on hand of $206.89, which, added to $68.54 still in the hands of the Secretary, makes the total amount on hand $275.43. The roll-call showed the following members present: J. W. SHANKS, A. C. STEVENS, R. HYLAND, S. R. PATCH, W. F. ELLIS, G. W. BISHOP, C. S. SHAFTER, W. E. CLARK, E. MERRILL, C. S. LANE, W. B. LUDWIG, C. LAVOIX, S. B. BODWELL, Jr., A. C. STICKNEY, W. P. MOSHER, W. HUTCHINSON.

The following new members were then elected: REUBEN J. COLLINS (Old Colony), J. SHANKS (Fitchburg), H. S. LEACH (Central Vermont), GEO. L. R. FRENCH (Boston & Maine), E. MORRILL (Boston & Maine), H. A. PHILLIP (Fitchburg).

After the reading of the constitution and by-laws, the following officers were elected for the ensuing year:

President, G. W. BISHOP (Fitchburg); Vice-President, W. E. CLARK (Vermont Valley); Chaplain, J. S. LANE (New York, New Haven & Hartford); Secretary, W. F. ELLIS (Providence & Worcester); Treasurer, W. F. ELLIS (Providence & Worcester); Executive Committee, C. S. LANE, J. W. SHAUPS, C. B. LENTELL, G. L. R. FRENCH.

The technical work was then taken up.

The first subject for discussion was "Repairs of Track," the committee on which were R. HYLAND, W. E. CLARK, and E. W. HORNER. The question was subdivided under four heads. Under "Method of Renewal of Rails, Frogs and Switches," the Committee recommended that renewals should be made by a special gang who curve and lay the iron and new joint-ties, and tamp, leaving the surfacing and removal of the old material to be done by the regular section gang.

In discussing this question not much difference of opinion appeared. All were substantially agreed that that was the best and most economical manner of renewing rails, but only the larger roads followed the plan. The smaller roads had to improvise a special track gang by robbing several section gangs of most of their men, or else put in new rail on each section as the hands there employed had opportunity. The point brought out was that it was the general custom now to begin with renewals each year where work had left off the preceding season, instead of putting in patches of new rails here and there according to former custom. Mr. ELLIS described his experience with a mixed track of 60-lb. and 72-lb. rail. He had been obliged to remove considerable 60-lb. rail, not at all badly worn, because the 72-lb. on each side of it rode so much easier that the 60-lb. rail seemed to be really worse than it was.

Mr. MOSHER (Boston & Albany) said that on that line, track renewals are made on Sunday by a large special gang which can put in one to three miles per day. As soon as possible afterward the section gangs nearest the new track, surface it and put it in proper shape.

The recommendations of the Committee on Section 2, "Best Method of Renewals of Ties and Tamping of the Same," were as follows: Put the best ties at joints, lining on one side on single track and on outside on double track. Put large end of ties on the inside of the curve. Tamp all ties with a bar. All renewals of ties should be made before July 1.

On the third division of the question, as to the best mode of ballasting and surfacing, the committee recommended that track be raised with jacks and the ties equally spaced and the ballast be then tamped with shovels. Afterward the track should be carefully surfaced and tamped with a bar.

As to the fourth question, maintenance and alignment of track on tangents and curves, the committee recommended as follows: Commence surfacing at end of section, where new ties commence; raise all low ties; use level on every joint; tamping all ties raised or loose with bars, lining each curve or tangent after it is tamped, and before filling in. Dress off last, leaving ballast as high as top of tie in center of track, and one inch of space under the rail; line of ditches parallel to the line of track.

The discussion of these questions showed a general uniformity of opinion among the members on most points. As to the use of jacks, some of the members were much more enthusiastic in their praise than others, but it was generally agreed that in raising track and sometimes in surfacing, a jack was a very valuable tool. Some members never permitted shovel tamping; others favored shovel tamping first, and bar tamping after the tie had been in the track three or four days. It was agreed that all roads would find it economy to put on force enough to complete all renewals of track before July 1. But not all the members were able to do this. The fact was alluded to that some managers expect heavier rails to decrease work on track so that heavier traffic would not necessitate a greater track force. This was a mistake. One member reported the use of a dynagraph car which greatly facilitated the work of surfacing on his road. The discussion of this subject was still in progress when adjournment was taken for supper.

The Convention reassembled at 8:30 P. M. and the discussion of the best method of ballasting and surfacing was taken up.

J. S. LANE (N. Y. N. H. & H.) described the first wooden frame jacks used on his road, and considered that even those crude styles had paid for themselves many times over. The saving in labor when raising track was at least one-sixth. He favored its use in general surfacing as well.

It was voted that the report of the committee as read be accepted. The report of Committee on Cattle Guards was read by Mr. MOSHER, and was as follows:

Cattle guards, as they exist on most railroads, are a nuisance, yet they are necessary at crossings where there are no flagmen. We are opposed to all trenches or pits with walled sides and stringers across lengthwise under the rails for the following reasons.

1. They are not effective. A case was instanced where a cow got partly into one and could not get out. A train came along and was derailed because the pilot could not get under the obstruction and throw it from the track. If there had been no pit there, the animal might have run clear of the train. If struck by the engine, in 99 cases out of 100 it would have been thrown to one side without damage to the train.

2. Few New England roads have any too much ballast under the tracks not affected by frost.

The trenches are 3 or 4 ft. deep and go through the road bed or gravel. The frost gets into the poor bottom, throws the track up, causing the trackmen to shim the track on both sides 3 or 4 ins. during the winter. When frost comes out, the guard remains high, and it takes constant care of section foremen to keep the place in good order. Our experience has been that it is almost impossible to keep these guards in good repair, so that they will not be felt by passengers in fast trains running over them.

The best guard that has come under our notice is called the "National Surface Guard." It is made in both wood and iron. The wooden ones are made of 3½-in. white oak sticks sawed diagonally. Three cornered strips, 12 ft. long, are spiked close together on top of the ties between the rails and tracks and run outside the tracks as far as necessary. Hundreds of them are in use in the West, and railroad men there say they work very satisfactorily. We therefore recommend the "National Surface Guard," either in iron or wood, as the cheapest, best, and most efficient cattle-guard. Of course, with a slightly different arrangement the guards may be made removable in winter for repairs to track.

C. B. LENTELL, }
C. S. SLAFTER, } *Committee.*

J. S. LANE stated that the law in Connecticut requires the use of an open pit. He had tried the open slats, as described in the report, and had been obliged to pay for some stock in consequence. Cattle would cross the open slats.

A. C. STICKNEY showed a blue print and gave a description of the standard guard in use on the Boston & Maine. It costs, outside of the ties, not over $6. Occasionally a steer or horse will cross these or jump these slats, but they will also jump pits.

J. W. SHANKS, described a style of slat cattleguard in use on the New London Northern, costing about $10. He was filling up his old cattle guards and putting in these slat guards.

W. E. CLARK.—The Railway Commissions of New Hampshire and Vermont approve of the slat guards in preference to the open pit. He favored placing the side fences 7 ft. from the track so that the snow-plow wings will not have to be moved inward.

Mr. FRENCH described the fence recommended by Commissioner PINGREE, of Vermont. It is the standard in use by the Delaware & Hudson Canal Co. and consists of one length of fence parallel to the track.

J. W. PATCH said that the material used for his guard was 4 ties 13 ft. long; 44 pieces 8 ft. long 3 ins. x 4 ins., chamfered on top to ½ in. They are placed 3 ins. apart at bottom. They cost for a single track $8.75 for material. At each end they are chamfered down the same as the crossing planks. It came out in the discussion that the distance between the slats should be great enough for an animal's hoof to go through if it stepped on it.

Mr. STICKNEY said that the object of the transverse rod is to keep people from tampering with the guard when simply spiked on. People come along with a stick and pry off the slats when they are simply spiked on, because they are inconvenient to walk over. The report of the committee was accepted.

An invitation was read from C. N. HAMMOND, Superintendent of the Boston, Revere Beach & Lynn R. R., extending the courtesies of the road to the members of the Association and their wives. A vote of thanks was made.

Unfinished and miscellaneous business was then taken up. It was voted that the next annual meeting be held in Boston, on the third Wednesday in August, 1890.

On motion of J. W. SHANKS, it was voted unanimously that the constitution be amended so that engineers or their assistants on maintenance of way may become members of the Association. The usual routine resolutions were passed and the Association adjourned until 9:30 A. M., Thursday.

EXHIBITS AT THE CONVENTION.

The ante-room of the Convention hall was devoted to an exhibit of the various appliances, in which roadmasters have special interest, some twenty or more firms being represented.

In rail saws, the Higley Sawing & Drilling Machine Co. showed their improved machine with samples of the work done. Large machines for shop use are now put on the market requiring about one H. P. to run and able to cutoff iron up to 12 x 12 ins. in size. The rail saw has been greatly simplified and improved. The style now put on the market has but four gears where the old machine had thirteen. The company was represented by Messrs. N. B. HAMMOND and ROBERT J. PRATT.

Samples of the work of the Smith reciprocating rail-saw, made by Manning, Maxwell & Moore, of New York City, were also on exhibition.

In hand-cars the Buda Foundry & Mfg. Co. of Buda Ill., showed the construction of their patent wood-wheel hand-car with seamless steel tires. The Sheffield hand-car was shown by GEO. J. AKERS, representing Fairbanks Morse & Co. This exhibit also included the Sheffield Automatic Stand Pipe and various styles of the Barrack track-jack.

The Maxon jack, made by D. E. McSherry & Co., of Dayton, O., was exhibited by C. O. ESTERBROCK. The Eureka jack, made by Josiah Barrett, Allegheny city, Pa., was also on exhibition, and Joyce, Cridland & Co., Dayton, O., represented by T. H. CRIDLAND, showed models of several styles of jack.

The Dunham Mfg. Co. were represented by G. H. BRYANT and J. CHURCHWARD and showed the Cloud double-angle joint, the Davies steel lock-spike, and the Davies spring nut-lock.

Other well-known styles of nut-lock shown were the Excelsior, double and single, made by Ruffner, Dunn & Co., of Schuylkill Falls, Pa. The National Lock Washer, represented by D. O. WARD; and the Noble nut-lock and washer, made by the A. French Spring Co., Pittsburg, Pa. Newer candidates for favor in the nut-lock line were the International Ratchet nut-lock, made by Beary & Hawk, Philadelphia, Pa., and the lock made by the Jones Safety Nut Lock Co. of Syracuse, N. Y., which firm also showed a positive switch-lock.

Among the other exhibits were the track-bolts made by J. H. Sternbergh & Son, of Reading, Pa., the well known Bush interlocking bolts, the Smith friction track-drill, made by the F. F. Waters Mfg. Co., of Boston, and the A. J. Hartford steel tie, shown by JAS. B. BRADY. The exhibit of the Weir Frog Co. consisted of photographs and blue prints of various forms of switches and cross-overs as erected on several leading railways. Also several types of spring-rail frog and samples of the die-pressed street-rail braces and switch fixtures made by the company.

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

American Association for the Advancement of Science.—Annual meeting at Toronto, Canada, Aug. 28. Secretary's office at Salem, Mass.

Civil Engineers' Society of St. Paul, Minn.—Next meeting, Sept. 2. Secy., Geo. L. Wilson, City Hall.

Western Society of Engineers, Chicago, Ill.—Next meeting, Sept. 4. "Compound Locomotives," G. A. Liljencrantz. Discussions on "Electric Underground Railways" and "Municipal Engineering in Large Cities." Secy., J. W. Weston, 78 La Salle St.

Association of Civil Engineers, Dallas, Tex.—Next regular meeting, Sept. 6. Secy., E. K. Smoot, Elm and Austin Sts.

Roadmasters' Association of America.—The annual convention will be held at Denver, Col., beginning Sept. 10. Secy., H. W. Reed, Waycross, Ga.

Boston Society of Civil Engineers.—Next meeting, Sept. 18. Secy., S. E. Tinkham, City Hall.

A SPASM of common sense has struck this year's Nominating Committee of the American Society of Civil Engineers. Always heretofore it has been the custom of that committee to evolve from the depths of its inner consciousness the names of the persons whom the Society ought to want as its officers, and it has in several recent instances been disagreeably surprised to find that its inner consciousness had deceived it. This year it has taken the precaution to issue the following circular:

SIR: The work of the Nominating Committee in past years has sometimes been criticised as not reflecting the wishes of the Society membership as to candidates for the various offices.

Will you kindly send to the Committee the name of Members whom you may consider desirable nominees for some or all of the various offices? The officers to be nominated are [etc., etc.]

The curious fact is that this should be the first time in the history of the Society that it seems to have occurred to a Nominating Committee that it might be well to find out if the membership in general had any preferences to express, before expressing their own. Even personal inquiries of friends have been rare. Considering that the Nominating Committee is chosen in a very informal way after impromptu nominations at the annual convention, and that their decision to nominate a candidate is equivalent to his election unless some one is so very much in earnest as to start a contest which, because of its rarity, seems obnoxiously personal, this fact is all the more surprising.

THE report of the Interstate Commerce Commission on Statistics of Railways shows 1488 different live corporations representing constructed lines in the United States, which we may assume to be nearly all there are. Of these only 611 are what may be called primary corporations, those operating their lines and issuing reports. The remaining 877 corporations are all of the second or third order, representing lines leased to or otherwise controlled by others, and hence continuing in existence only for financial purposes. Of the 611 which appear to be primary corporations, moreover, a great many are not such in fact. Quite a number of them are large aggregations, like the Pennsylvania Company, Lake Shore & Michigan Southern, Michigan Central, Union Pacific, etc.; nominally independent lines, yet really "but parts of one stupendous whole;" and the same is true of a very large proportion of the other and smaller lines, which are controlled by identity of ownership, ownership of large stock interests, lack of other connections, etc., etc.; so that if we take out the mileage controlled by 40 or 50 great systems, there is but a small and unimportant mileage left. It would really seem as if the consolidation under one management of the 40 or 50 systems which includes all our really independent lines of any importance would be a less violent step in advance than was the consolidation of the thousands of corporations which once had independent existence into the 40 or 50 which are now alone independent and of any importance. But, on the other hand, we have precedents throughout the world for the rapid consolidation of railways into a few great systems in each country, whereas we have none (with the partial exception of Germany and Holland) for the process going any further

THE same report also gives the first complete statistics of any subdivisions of operating statistics for the whole United States which have appeared since the U. S. census of 1880 "Poor" making no attempt to give more than the aggregates of operating expenses. The subdivision is only into four great items, but has a certain interest and value, especially as the same subdivision and the percentages thereof is given for every single railway company in the United States. No attempt is made to give these figures for separate States or groups of States, but in the aggregate they are as follows:

Details of U. S. Operating Expenses, 1888.

	Amount 1=$1,000,000.	P. c. of total op'g exp.	Proportion assigned to pass.	Proportion assigned to frt.
Maint. way and struc.	134.45	22.60	37.85	62.15
" equipment	101.65	17.09	32.46	67.54
Conducting transp'n	299.05	50.26	33.86	66.14
General	55.60	9.34	39.05	60.96
Unexplained	4.25	0.71		
Total	595.00	100.00	33.64 cts.	66.36 cts.
Cost per train mile, average 96.05 cts.			84.69	103.88
Cost per ton or pass. mile			2.042	0.630

The classification of expenses adopted in preparing the above condensed items is a very poor one, but comparing on this basis with the U. S. census statistics of 1880, we have the following comparison:

Percentages of Total Expenses, U. S.

	1880.	1888.
Maint. way, etc	24.30	22.60
" equipt	18.02	17.09
Operating and genl	57.68	60.31
Total	100.00	100.00

There will be seen to be an apparent tendency toward reduction of the relative cost of Maintenance of Way and Equipment, and toward increase in Train and General Expenses. This would seem *a priori* a natural result from increase of traffic. We question if the 1890 census will show the same tendency to the same extent, however, but in the mean time note the fact.

THE aggregate of accidental deaths from causes quite other than railway disasters reaches larger totals than most people realize. Railway accidents have about them more or less of the spectacular and so attract general attention. The innumerable multitude of disasters to single individuals are hardly noticed at all.

Owing to the imperfect manner in which vital statistics of all kinds are gathered in this country, it is impossible to give accurate figures for accidental deaths in the United States as a whole, or even in single States, one or two excepted; but a recent classified statement by the Board of Health of the accidental deaths in New York City alone, in the year 1888, afford some means of judging what the aggregate of accidental deaths must be. In the 1880 census, New York city contained about $\frac{1}{41.6}$ part of the total population. In the 1870 census it contained about $\frac{1}{41.0}$ part. Assuming that accidental deaths are about in proportion to population, which we will shortly show it is fair to do, and that they are, say, 40 times as many in the whole country as in New York city, we have the following startling aggregate, the figures for New York being official, and those for the whole country deduced therefrom by multiplying by 40;

ACCIDENTAL DEATHS, 1888.

	N. Y. City.	Total U. S.
Fractures and contusions	154	6,160
Drowning	173	6,920
Neglect and exposure	9	360
Falls	391	15,640
Burns and scalds	122	4 880
Suffocation	85	3,400
Poison	173	6,920
Run over (exclusive of horse cars)	55	
Run over on railways (including 14 by horse cars)	64	2,200 2,960
Electric-light wires	5	200
Explosions	3	120
Malpractice	3	120
Wounds	21	840
Total	1,258	50,320

In contrast with this fearful aggregate, we have the fact that only from 1,200 to 1,400 deaths by railway train accidents appear to have occurred in this country, or about as many as the accidental deaths from all causes in New York city alone.

THAT this total approximates accuracy is shown by the fact that in both Great Britian and the United States the aggregate of accidental deaths is somewhat over 3 per cent. of the total death rate, which in the United States is rather less than 2 per cent. annually of the total population. This accounts for nearly 40,000 such deaths, and the U. S. statistics err gravely by omission. In Great Britain, in 1881, there were 670 accidental deaths per million of population, which is equivalent to 43,550 for a population of 65,000,000; but the rate has been steadily rising in England, having increased from 22 per 1,000 deaths in 1861 to 30.9 per 1,000 deaths in 1881, and there is every reason to believe that the proportion of accidental deaths is somewhat larger here than there. It is to be noted also that the above figures do not include murders and suicides, which in England add 13 per cent. (murders only, 2½ per cent.) to the total of accidental deaths proper.

From all these facts it appears clear that the ratio of accidental deaths in cities is not sensibly higher than in the country, despite the causes which might be supposed to tend to a larger number of accidents in cities: and this is proved directly by English statistics, which show an almost identical accidental death rate for London and for England as a whole, London's rate being slightly the lower, namely, 665 against 670 per million inhabitants.

THE Philadelphia *Inquirer* of Aug. 9 publishes nearly a page of matter relating to the "Flame of Death" from gasoline, called out by some discoveries as to violation of law in its storage. Among other things, it gives an interesting summary of the accidents in Philadelphia alone from gasoline in recent years, which we condense as follows:

1880: 125 fires caused by its use in stoves, cans, and lamps.
1881: 17 explosions of gasoline lamps, 12 of cans, 3 of stoves.
1882: 5 explosions of lamps, 9 of stoves, 9 of cans, all causing more or less injury to persons.
1883: 5 explosions of cans, 1 of gas machine, 6 of stoves.
1884: 19 fires, 8 from explosions of lamps, 7 from gasoline stoves.
1885: 111 fires "caused by careless use and explosion of gasoline lamps and stoves, many of which were attended by disastrous consequences and loss of life."
1886: Report not published. By informal reports of Insurance Patrol, 7 explosions of lamps, 4 of stoves, 3 of cans.
1887: 4 explosions of cans, 3 of lamps, 5 of stoves. One of these injured 17, of whom 7 died.
1888: 6 explosions of lamps, 11 of stoves, 6 of cans.
1889 (partial list to date): 2 women burned; 1 man burned to death; bad fire on ship from gasoline stored in hold; 1 explosion from vapor lighted by a lantern.

Considering how extremely rare the use of gasoline in any form is among intelligent city residents, this is a fearful list of casualties, albeit we may be quite sure it is far from complete, most people vitiating insurance by having gasoline stored about their premises. It again illustrates how essentially indefensible and unwise is the use of gasoline in any form for the lighting of cars, the objection to it not being (let us grant for argument) that the apparatus is any less safe than would be hermetically sealed tanks of gasoline along the roof of the car, but to the carrying of such tanks in any position about passenger cars. What would be thought of a company which for the sake of an addition to its express receipts should arrange to carry six such tanks, holding two gallons each, along the roof of every passenger train car? Every one can see that it would be morally indefensible to thus tamper with what is practically an explosive; and the profit from using gasoline as an illuminant is not really any greater than the express rates on it, when all expenses of insurance, etc., are taken into account.

WE continue to receive frequent inquiries as to whether Mr. WELLINGTON'S announced "Manual of Railway Field Work" has yet been published, and especially as to whether his method of laying out transition curves is yet in press. To all such inquiries we may say once more that various circumstances have prevented the publication of the "Field-Book" as early as was expected. We shall begin the publication of it serially in these columns about October 4, and the chapter on transition curves will be published in advance, out of order, soon after this publication has begun, in order to give inquirers the information they desire as soon as possible. In the meantime, such inquiries will have to remain unanswered. The "Field-Book" will first be published serially, omitting the merely formal parts, in the belief that it will be interesting matter to a large proportion of our readers, many of the problems and methods given being new in form or in substance, while it will make certain parts of it, as especially that on transition curves, available sooner than they otherwise could be; and the suggestions and discussions which such publication may bring out will help to insure that the work as finally published will be in the best form for general use.

The Railways of the United States in 1888.

II.

It is an unfortunate defect of the introduction of Poor's *Manual* that it ignores Canada entirely. As the figures for the separate railways are given for Canada as well as for the United States, the reason for this is not apparent, and it would add greatly to the interest of the introduction if the Canadian and American railway totals and averages could be compared.

We shall confine ourselves in this article rather to the drawing of certain deductions from Poor's statistics than to a mere rehearsal of the statistics themselves, the most important parts of which we gave last week. One of the most interesting of all facts connected with railway returns is the comparative freight-train loads, which are deduced below for 1887 and 1888, showing an even more than usually marked continuation of the astounding progress in this direction which has marked the recent history of American railways. We add the statistics for 1885 for comparison. In each case there is a trifling amount (some 2½ per cent.) of mixed train mileage neglected, these mixed trains carrying possibly 1½ per cent. of the freight, so that the train loads below are by that amount too large; but even making this allowance (which does not affect the comparison between years), the result is phenomenal, and quite without parallel in any other part of the world.

Average Freight-Train Load, Tons.

Group.	1885	1887	1888	Incr. 85-8.	p. c.
New England	102	109	113	11	10.8
Middle	179	188	193	14	7.8
No. Central	139	162	162	23	16.5
No. Western	148	153	160	12	8.2
So. Atlantic	93¼	117	129	25¾	27.2
So. Central	125	131	137	12	9.6
So. Western	118	129	107	—11	....
Pacific	115	156	165	50	43.4
Total United States	143	156	172	29	20.2

The greatest increases are, in order, in the Pacific, South Atlantic, and North Central groups, the first two of which were among the lowest in absolute train load in 1885; but all the groups show a handsome and very rapid increase, New England on the whole making the poorest showing, a fact intimately connected with the character of its traffic, largely short-haul and local.

The record for the whole United States since 1880 stands as follows:

Average Freight-Train Loads, U. S., Tons.

1880	1882	1883	1884	1885	1886	1887	1888
129	129	126	134	143	151	156	172
Incr.	0	—3	8	9	8	7	16

Considering that this tendency to increased train loads began long before 1880, this tendency to continued rapid growth is very remarkable. While the statistics for the whole United States are not sufficiently complete to assert the fact positively, it is a practical certainty that the average freight-train load in 1870 did not much, if at all, exceed 60 tons, or half the load of 1880 and about one-third that of 1888. That so great an increase can have occurred will appear more probable from the following figures for single roads, which, with most of the other statistics of this article not referring to the current year, we extract from tables in the "Economic Theory of the Location of Railways."

Increase of Average Freight Train Loads, 1873-1880.

Road.	Tons, Av. 1873	Load, 1880	Incr.	p. c.
Lake Shore & M. S.	130	252	116	85.3
N. Y. Central & H. R.	120	219	99	69.7
N. Y., L. Erie & W.	132*	211	79	59.8
Pennsylvania	111	184	73	65.7
Boston & Albany	75	97	22	29.3
Del. Lacka. & W.	79*	90	11	13.9
Mich. Central	135*	201	66	48.8
Pitts., Cinc. & St. L.	88	125	37	86.5
Pittsb'g, Ft. W. & C.	89	166	77	42.1
Illinois Cent.	83	110	27	32.5
Chic. & Alton	119*	189	70	58.8
Cl'd, Col., Cinc. & Ind.	79	122	43	54.4

* These figures are for 1874-1875.

The year just passed shows the largest increase of any in the series since 1880, and shows a train load just 43 tons or 33⅓ per cent. greater than in 1880, during which period the total tonnage movement has increased from 32.35 to 61.56 *billion* ton-miles, or 91 per cent., the average haul having remained practically constant at 111 miles, a very long haul indeed compared with that of any country in Europe, and so in part explaining our vastly lower rates.

Nevertheless, those countries ought to show progress from one year to another, as we show it, since our longer haul remains constant, while their traffic is also rapidly increasing, although much less rapidly than our own. With partial exceptions, they do not show any such progress as we do in reduction of rates, which has gone on in recent years at the following remarkable ratio:

Receipts per Ton per Mile, U. S., Cents.

1880.	1883.	1884.	1885.	1886.	1887.	1888.
1.29	1.236	1.124	1.057	1.042	1.034	0.907

The decrease is 0.383 cent, or 42.3 per cent. of the present rate, so that, in a general way, we may say that the average American train now carries a third more tonnage for 10 per cent. less money. The great change in this respect, which is now going on, is so often and so fully discussed that we do not care to burden this article with multipled evidence of it, but perhaps the following figures, dating back to 1865, will bear repetition:

Rates per Ton per Mile.—Six Eastern Trunk Lines.

1865.	1870.	1875.	1880.	1885.	1887.	1888.
2,900	1,593	1,161	.869	.636	.718	.609

Rates per Ton per Mile.—Six Western (Chicago) Systems.

3.642	2.423	1.979	1.389	1.158	1.014	.934

It is to be remembered that there was a premium of 57 per cent. on gold in 1865, and of 14 per cent. as late as 1875. Reducing to a gold basis, we have the above figures:

1865.	1870.	1875.	1880.	1885.	1887.	1888.
1.85	1.68	1.42	.869	.636	.718	.609
2.33	2.11	1.74	1.389	1.158	1.014	.934

On this basis the average percentages of annual decrease in rates are:

	1865-70	1870-75	1875-80	1880-85	1885-88
East of Chicago	5.1	5.2	3.0	5.3	1.4
West " "	2.0	3.5	4.0	3.4	6.5

It will be seen that the movement toward reduction advanced much more slowly west of Chicago than east of it, but is now going on in accelerated ratio. In 1885 the average western rate was 82 per cent. higher than the average eastern rate; but it is now only 53 per cent. higher.

It was not uncommon, even in 1880, for people to rejoice over the great fall in rates, but remark that it could not go much farther. It is still common now. We are satisfied, however, that rates have not even now approached their lowest figure, but that they will continue to fall, and quite rapidly, until they are less than half what they are now. We feel the more sure of this because the volume of traffic seems to be a leading factor in reduction of rates, and this, on the above-given systems, has increased in the following marvelous ratio:

Millions of Ton Miles.—Six Eastern Trunk Lines.

1865	1870	1875	1880	1885	1887	1888
1,649	3,086	5,905	10,313	11,301	13,543	13,868

Six Western (Chicago) Systems.

513	1,234	1,905	4,168	6,500	7,776	7,969

The last given systems have, of course, increased greatly in mileage during this period, but the first not noticeably, and the great growth of traffic is striking from any point of view, albeit less noticeable on these lines since 1880 than before.

For the whole United States, however, the increase since 1880 is very noticeable, as above given, being not less than 91 per cent. in freight movement, during which period the mileage in operation has increased about 77 per cent. and population possibly 30 per cent. These figures make it evident how much the growth of traffic on old lines is kept down by constant new constructions, despite which, the increase on old lines is tolerably rapid.

That the larger train load is the most important single agent for reducing rates is indicated negatively by the fact that passenger train loads hardly grow at all, and rates hardly fall at all, despite rapid increase in the total passenger movement. For the whole United States the rates have been:

Receipts per Passenger Mile, U. S., Cents.

1880	1883	1884	1885	1886	1887	1888
2.51	2.42	2.36	2.20	2.18	2.28	2.25

During this period the growth of passenger-mileage has been from 5,740 to 11,191 millions, an increase of 5,451 millions, or 95 per cent., being even more than the freight growth, and implying that (calling the increase of population 30 per cent.) the average American travels just 50 per cent. more than he did in 1880. The passenger train-mileage has increased nearly as fast during the same period, however, so that the average passenger train-load has remained practically constant, as follows:

1880	1883	1884	1885	1886	1887	1888
41.5	45.7	42.4	43.1	46.2	44.4	41.7

The leading factor in the slow growth of train loads is undoubtedly the enormous increase in the use of parlor and sleeping cars, but the contrast between passenger and freight tendencies is still a curious one.

For the first time "Poor" gives deduced statistics for the several groups, from which some very curious comparisons can be made. The earnings and expenses per train mile for the several groups contrast as follows:

1888.	*Earnings per Pass.*	*Train Mile Freight.*	*Expenses per N.M. Av'ge.*
New Eng.	$1.193	$1.717	$1.119
Middle	.812	1.607	.857
No. Cent.	.868	1.309	.857
No. West.	1.127	1.941	1.108*
So. Atl.	.898	1.582	.953
So. Cent.	.863	1.488	.857
So. West.	.941	1.629	.903
Pacific	1.707	2.781	1.346
Total U. S.	.937	1.557	.948
U. S. 1887.	1.008	1.615	.931

* This is the figure given for 1887; for 1888 the evidently erroneous figure of 56.9 cts. is given.

The tendency of operating expenses to fluctuate around about $1 per train mile, and for passenger trains to earn somewhat less than the average cost of running trains, is notable. As we may be quite sure that passenger trains would not be run at a loss, nor probably without returning about the same percentage of profit as the freight tonnage, we may conclude with some certainty that the factor of high speed is a vastly less important one than low weight, smooth springs, and saving of time en route. As we have often said before, when close couplers, better springs, and air brakes shall have made a fast *yet variable* speed—fast down-hill and slow up-hill—practicable for freight trains, and at the same time have given smoother motion, a vast economy in cost of transit will result. The average train-load will be not less but more than now, although the speed be double, and in many ways the change will tend to large economies, while it will also tend to hold up rates by giving quicker transit.

"Poor" gives a very interesting table, which we reproduced last week, of areas, 1889 population, miles of railway and assessed valuation, with the relationships between them. The assessed valuation shows a total of 20,958 million dollars, as "Poor" gives it, or, correcting an enormous apparent error below noted,* 22,958 millions, as against 16,903 millions by the 1880 census, an increase of only 35¾ per cent. in nearly a decade. It is quite certain that this is far below the real increase; and how absurdly lawless these assessed valuations are may be indicated by comparing a few of the States, as follows;

Increase in Assessed Valuation, 1880-88.

	p. c.		p. c.		p. c.
Me.	00	N. Y.	31	Va	28
N. H.	53	N. J.	2½	W. Va	28
Vt.	84	Penn.	45	N. C.	36
Mass.	23			S. C.	5½
R. I.	30	Md.	(−2)	Ga	49
Conn.	10¼			Fla.	178
				Ala.	75
N. Eng.	23	Middle	29	Miss.	17
				La	29
		Ohio	11	Tex.	113
		Ind.	6	Ark.	71
		Ill.	2	Ky.	61
		Mich.	86	Tenn.	53
		Wis.	32		
		No. Cent.	20	South.	87

There is no doubt that the South has been advancing very rapidly since 1880, and it is possible that these figures are relatively correct as regards that section; but it is not possible that the North-Central group, Maryland, New Jersey, Maine, etc., have been really standing still or running behindhand in the extraordinary fashion shown. If we may attach any significance at all to the assessed valuation figures, the Southern States above show the following gratifying advance, using New England for comparison:

Assessed Valuation, Millions of Dollars.

	1880	1888	*Incr.*
6 New Eng. States	2,652	3,263	611
13 Southern States	2,371	4,444	2,073

The unreliability of these statistics, however, is no fault of Poor's, and he shows commendable enterprise in giving the table just noted in the same year as that of the statistics on which it is based. He omits one most significant factor, however,—the payments to railways per head of population, and this we supply in the following table, accepting Poor's figures for population, and giving some prior years for comparison.

Total Railway Revenue per Head of Population.

	1875.	1880.	1889.
New Eng.	$12.90	$12.19	$15.55
Middle	15.44	16.03	17.80
No. West.			16.92
No. Cent.	12.01	14.55	13.76
So. West.			13.11
So. Atl.			6.03
So. Cent.	4.44	3.96	5.94
Pacific	17.99	18.45	26.25
U. S.	11.43	12.25	14.58

The tendency to rapid growth in payments *per head* to railways is decided, despite the rapid fall in rates. In 1871-72 the payments per head in the entire United States averaged only $8.57, or barely half what they are now, despite the much higher rates of that day, which, as above given, were 2.6 times what they are now.

That this results not simply from increase in the bulk of products which must be transported, but is largely in the nature of indulgence in luxury, is evident from the corresponding statistics for passenger traffic only:

* "Poor" gives the assessed valuation of Pennsylvania as only 430 millions against New York's 3,469 millions, whereas in 1880, Pennsylvania had 1,983 millions against New York's 2,652 millions. It is probable that "Poor's" 430 should really be 2,430, a trifling difference of $2,000,000,000.

Passenger Revenue per Head of Population.

	1875.	1880.	1889.
New Eng.	$5.80	$4.82	$6.98
Middle	3.60	3.63	4.32
No. Cent.			4.33
No. West.	3.21	3.21	3.35
So. West.			3.17
So. Atl.			1.60
So. Cent.	1.22	0.86	1.49
Pacific	5.39	5.68	7.06
U. S.	3.16	2.94	3.84

In no other year in the history of the country were the passenger payments to railways so large as last year, either in the United States or (with one or two petty exceptions) in any group of States. The eastern and western extremes of the country pay in the largest passenger revenue, perhaps in part because they are the extremes. Taking in view the immense contributions of the outlying groups to the railway revenue of what is well termed the "Middle" group, the aggregate for that section which can be assumed to be contributed by its own population seems surprisingly small,—not very much larger than for the Southern groups.

"Poor" gives a table of the railway mileage of the world by countries, extending up to 1887 only, which is somewhat ancient history, but from which we can deduce a comparison of some little interest. A moderate amount of enterprise would have caused this table to be given in miles instead of kilometers, and for the current year instead of for the year before. The percentage of increase in the 7 years 1880-87 for various countries has been as follows:

1 kilo. = 0.621 miles.	*Kilos. R. R.* 1887.	*Incr. p. c.* 1880-87.
United States	241,210	60.0
Canada	19,883	70.3
Total America	290,318	65.7
Great Britain	31,521	9.2
France	34,208	32.0
Germany	39,785	16.5
Total Europe	207,806	23.2
India	22,665	54.0
Total Asia	26,898	69.7
Total Africa	7,716	66.5
Total Australia	15,397	95.5
The World	548,035	47.3

Australia, India, and Canada show very large increase, but from a small previous total. Europe as a whole increases very slowly, and Great Britain with remarkable slowness, considering how poorly Ireland is yet provided. The United States built 51½ per cent. of the whole construction of this period.

State Supervision of Dams and Reservoirs

In another part of this issue we review the annual reports of the Rhode Island Commissioners of Dams and Reservoirs for the years 1882-88, inclusive. Since its establishment, the office of commissioner has been filled by L. M. E. Stone, and the work he has done, and the statute provisions under which he has accomplished so much, are full of suggestions, especially when compared with the corresponding statutes in Massachusetts and Connecticut.

Connecticut in 1878 (Senate Bill No. 51) provided for the appointment of one civil engineer from each congressional district, these, with that member of the State Railway Commission who is a civil engineer, to constitute a Board having supervision of all dams and reservoirs within the State the breaking away of which would endanger life or property. Plans for all new dams must be approved by one of these inspectors, who also supervises construction. Until two or more persons or corporations, whose lives or property would be in danger should a dam or reservoir fail, apply to the town officials,

and until these examine the structure, pronounce it unsafe, and call upon an inspector, he can take no action regarding a dangerous existing dam. The members of the Board are appointed for terms of two years, and receive $10 a day and expenses for their services when employed. If engaged on existing dams, the State pays the inspector, but for services on new dams the proprietor must bear the expense, providing the dam was faulty; otherwise the town in which the dam or reservoir is located must pay the inspector. Those desiring an inspector can call upon any one of the Board. If upon examination the inspector finds a dam unsafe, he notifies the owner to repair it. The repairs are made under the inspector's supervision, and when satisfactorily completed he gives the owners a certificate to that effect, and causes a copy of the same, and a description of his action, to be entered in the town records. Section 7 of the bill provides that "the Superior Court shall have jurisdiction in equity, and may make all judgments and decrees necessary to carry into effect the provisions" cited above.

Chapter 190, p. 1093, of the Public Statutes of Massachusetts, provides that upon the application of any property-holder below any reservoir or dam, the County Commissioners shall examine said reservoir or dam, and if in their judgment the same is unsafe, they can order repairs. If their orders are not obeyed, the commissioners cannot cause the repairs to be made, but they have power to remove the dam.

Chapter 271 of the Public Laws of Rhode Island provides that the Governor shall nominate, and by and with the consent of the Senate appoint, a commissioner of dams and reservoirs, who shall hold office for three years, or until a successor is appointed, at a salary of $1 000 a year. It is the duty of the commissioner to inspect each dam and reservoir in the State as often as is necessary to keep himself informed regarding its condition. "No dam or reservoir shall be constructed or substantially altered until plans and specifications of the proposed work shall have been filed with the commissioner."

Upon petition in writing by any person, city, or town whose property would be liable to injury or destruction from the breaking of any reservoir or dam, or without such complaint, when the commissioner thinks a dam unsafe, it is his duty to examine the same, and to order, in writing, such repairs as may be deemed by him to be necessary, the repairs to be made within a limited time. Or, in such case, he has power to have the water drawn off in whole or in part. If the person thus notified does not act accordingly, the commissioner reports him to the attorney-general, who lays the matter before the Supreme Court, where the case is settled. In specific cases, the commissioner may employ, at the expense of the State, a consulting engineer.

Upon written request from the commissioner, any person owning or controlling a dam or reservoir must furnish at once as full a description of the same as is practicable, and cause to be made, as soon as may be, all surveys, plans, and drawings of the structure that the commissioner requires. In January of each year the commissioner must report to the Governor of the State the work he has done the preceding year.

Perhaps in no other States in the Union is a strict supervision of dams and reservoirs more necessary than in these three. This is made evident when we consider the density of the population and its distribution along water courses, the large number of dams and reservoirs along these streams for public water supply and manufacturing purposes, and the hilly nature of much of the country, with large reservoirs above the villages and cities. There are in these States about 200 water-works, fully 75 per cent. of which have reservoirs connected with them. Of the total water power utilized in the United States in 1880, one-sixth, or 222,000 out of 1,225,000 H. P., was in these three States, distributed as follows: Massachusetts, 138,362; Connecticut, 61,205; Rhode Island, 22,240 H. P.

Rhode Island, with but 10 per cent. of the total utilized water-power of these States, 1.8 per cent. of the total water-power, 0.055 per cent of the total population, and 0.004 per cent. of the total area of the United States, is the only State which has adequately provided for the protection of its people and property from the destruction which may follow upon the breaking of dams and the floods that follow. We say "adequately provided"; but for all the precautions taken, the great flood of Feb. 13, 1886, carried away five dams on the one small stream known as Abbott's run, in the vicinity of Pawtucket, besides many others, and had not the ground been frozen at the time, it does not seem improbable that a quarter of all the dams in the State would have been destroyed.

New York had, in 1880, a utilized water-power of 219,348, and Pennsylvania of 110,276 H. P. Besides the large dams and reservoirs connected with water-power privileges, there are many others for public water supply, and some very large ones to store water to feed canals. There are no officials especially appointed to supervise these dams, and so far as we know, the proprietor of a dangerous structure could be made to repair or remove it only upon its being condemned by the courts as a public nuisance, or as a menace to life and property.

To return to the statutes of the States under consideration, we find those of Rhode Island to be the only ones adapted to and meeting existing conditions. For in Rhode Island alone is there provision for the inspection of every dam and reservoir in the State as often as may be necessary, and also provision for a complete record of a description of each structure, based upon surveys and supplemented by drawings. Nor is there in the other States so adequate a provision for the speedy detection and repairs of a faulty structure, since the Commissioner knows the condition of each structure, and can cause it to be repaired, and the people, if they think their life or property in danger, can call upon the commissioner to inspect any dam or reservoir.

Plans and specifications for dams and reservoirs in Rhode Island must be filed with the commissioner, as well as alterations to existing structures. Perhaps in this one respect the Connecticut statutes are superior to those of Rhode Island, for in the former State the plans must be submitted to an inspector, who examines both them and the ground upon which the structure is to be located, and work cannot be commenced until the inspector issues a certificate of authorization. During construction the same inspector must cause the dam to be inspected at least three times before its completion. After completion the structure cannot be used until the inspector is satisfied that it has been built "in accordance with the plans and specifications approved by him, and is strong and secure," and gives and causes to be recorded in the office of the town clerk for the town where the dam is located, a certificate to that effect. The provisions of each State tend to insure that dams and reservoirs will be properly designed, and those of Connecticut provide for good construction. As the Rhode Island statute reads, plans and specifications are only filed with the commissioner, not approved by him, and strictly interpreted he has nothing to say until the structure is completed. But the fact that he can then condemn it and cause repairs to be made, probably answers nearly the same purpose as the necessity of his approving the plans and specifications. While there may be an advantage in having the Connecticut inspectors supervise the construction of new dams, it cannot be denied that if the method followed in Rhode Island results in a realization of responsibility on the part of those building new structures, an important step will have been taken in the right direction. For the true province of State supervision is not to lessen but to increase the sense of this responsibility, so that the standard of safety and durability may thus be continually raised until State supervision is almost or quite uncalled for.

The great deficiency in the Connecticut statutes is that the inspectors have no independent power regarding existing structures, however bad they may be known to be, and that no provision is made for them to ascertain the status of all dams and reservoirs in the State. The public safety depends entirely upon the watchfulness and care of the owners of this class of structures, and of persons living below them. Even when two or more persons are alarmed regarding the safety of a dam or reservoir they cannot at once call for an inspector, but must notify the town officials, who by an examination determine whether an inspector's services are needed.

In Massachusetts the case is still worse, for there, there are no inspectors or commissioners, and instead of calling upon town officials, who are more likely to be interested on account of their own safety, the County Commissioners decide whether repairs are needed. While they can engage a consulting engineer, they are none too likely to do this, and to put it mildly, an average County Commissioner's knowledge of dams and reservoirs is limited. Added to the above is the fact that the Massachusetts County Commissioners cannot cause needed repairs to be made. Although they have power to remove the structure, if not repaired, they would not do this except in extreme cases, for it would be evident folly to remove a dam for a seemingly slight defect. Yet the Massachussetts statutes are a step in the right direction, even if a comparatively short one.

The great deficiency with both the Massachussetts and Connecticut statutes is that the general public is its own guardian, except as regards new dams in the latter State. And the general public has no engineering knowledge, and is extremely liable to be indifferent until the breaking of such a dam as the South Fork, and then over-vigilant for a time. If the South Fork dam had been in Rhode Island we may safely assume that the Commissioner of Dams and Reservoirs would have discovered its dangerous condition long ago, and would not only have ordered the obstructions to be removed from its spillway, but also would have enforced his order, through the State Attorney and Supreme Court, if necessary. If the dam had been in Connecticut, perhaps two people below it would have asked the town officials to have it examined, and thus the disaster might have been averted. But action might have been delayed until too late, or never taken, owing to general indifference, the long pre-

liminary process which is necessary, and the fact that the town officials would have power to dismiss the matter without calling for an inspector. In Massachusetts the same chances against the condemnation of the structure would have existed, and they might have been doubled. Even if the County Commissioners ordered repairs they could not enforce their orders, and if they appreciated the real difficulty, the obstructed spillway, one can hardly imagine a Board of County Commissioners courageous enough to destroy so large a dam because its spillway was faulty.

In two years after the appointment of Commissioner STONE, he had inspected each dam and reservoir in Rhode Island, and made a record of its dimensions and other characteristics, noting especially those dams that were weak. In each of the last five years he has examined every important structure, and when repairs were necessary he has ordered them. They have generally been made without troublesome opposition, and when necessary the State Attorney and the Supreme Court have enforced the commissioner's orders. The advantage of having the knowledge such inspection gives, and the power to cause repairs to be made when necessary, is evident, as is also the inefficiency of both the Connecticut and Massachusetts statutes.

Connecticut, we are informed by Inspector B. H. HULL, of Bridgeport, now realizes the defects in its statutes, and will probably soon take steps to remedy them. The inspectors seem to be quite popular with owners of water privileges, dams, and reservoirs, and Mr. HULL says the latter persons often ask for an inspector, as they value the certificates given and the knowledge that the structures inspected are safe.

It is to be regretted that so densely populated a State as Massachusetts, with so many large dams and reservoirs, should have no supervision over those structures. And in view of the number of dams and reservoirs in other States than these three, and the life and property involved, it is still more to be regretted that they make no attempt at any supervision.

Massachusetts, New York, Pennsylvania, and as many other States as have a large utilized water-power, or large dams for other purposes, should have as efficient inspection and supervision as Rhode Island. If that cannot be, these, and all other States in the Union, can at least appoint a commission of able engineers to examine each dam and reservoir within its limits, record its location and characteristics, determine which, if any, need repairs, and have such repairs made under their direction.

The cost of systematic and thorough supervision in Rhode Island has not been great, not great enough. The salary of the commissioner is the ridiculously small sum of $1,000 a year, and if the traveling and other expenses of his office are as much more, the total is but $2,000, or less than $5 a year, each, for the 434 dams and reservoirs within the State. The State evidently counted, and in this case with reason, on obtaining the services of a competent and vigilant officer, who would find his compensation in the honor and utility of the office rather than in the salary paid. But such expectations are usually both foolish and hopeless. A proper salary to secure an expert should be paid. But who can estimate the saving that might have been effected had there been in Pennsylvania such State supervision as would have averted the Johnstown disaster? New York City and Brooklyn together contributed over $1,000,000 for the Johnstown sufferers, which sum alone, at the above figures for Rhode Island, would have paid for the inspection of 200,000 dams for one year.

There can be no better time than the present to secure the legislation needed in the various States, and the engineering profession throughout the country should use its influence to that end.

CORRESPONDENCE.

A Turbine Problem.

CHATTANOOGA, TENN., Aug 19, 1889

TO THE EDITOR OF ENGINEERING NEWS:—

What will be the net horse-power, through a single turbine, head 800 ft., diameter pipe 20 ins.?

Yours truly,
J. A. GILLESPIE, C. E.

[Our correspondent fails to give the length of the supply main in securing this 800 ft. head and consequently the loss in pipe friction. But assuming a discharge of about 480 cu. ft. per second, not taking friction into account, we would have an efficient horse power of about 32,000.—ED. ENG. NEWS.]

The South Fork Dam Disaster.

Michigan Central Railroad Co.,
DETROIT, Mich., June 29, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

I have read with much interest your lucid accounts of the South Fork Dam Disaster, but as to that wall of water 40 ft. in height tumbling over itself, wheel fashion, I submit the inquiry as to a possible optical delusion on the part of the observers, similar to that, which leads to the popular belief in ocean waves of that and greater height. I quite agree with your calculated force of the flood and to a wall of moderate height tumbling surf-like, but would suggest the opinion, that, given at any instance a 40-ft. wall of water, the pressure due to static head would cause the flood to take the form of a blunt wedge as it advanced down the valley, the point of most rapid flow being lowered from where it would be in the case of an ordinary stream to some point but little above the bottom obstructions, in accordance with Toricelli's law; this point being where static head pressure, minus friction transmitted through the lower layer of water from the bottom, was at maximum.

Yours truly, E. FISHER,
Assistant Engineer.

[We are not aware of having certified to any "wal. of water 40 ft. high." The mud line in the buildings, however, testifies to a water level 20 to 30 ft. or more above the normal, and it is quite possible that at certain points in the upper valley it may have been as high as 40 ft.

As for the "wall" part, if our correspondent will go to the town of Moncton, N. B., at the head of the Bay of Fundy, he will see there twice a day a phenomenon known as the "bore," viz., a "wall of water" 8 to 10 ft. high in advance of the incoming tidal wave. In the Ganges these "bores" are about 12 ft. high; in the Amazon and some other rivers of Brazil they are from 12 to 16 ft. high. Their cause is thus defined in the new "Century Dictionary":

The tidal wave being a wave of translation, the shoaling and narrowing of channels where the tide rises very rapidly produce a great increase in the height of the wave. The forward parts of the wave, too, in the shoaling water, advance less rapidly than the backward parts, and so cause a great accumulation in front.

If so slight a provoking cause as the rise of even the highest tides can cause such "walls" of water as this, what might be expected to result from the sudden breaking away of a great reservoir 72 ft. high? Whatever the answer to this question, however, the above is at least evidence that such "walls" of water do exist and maintain themselves, despite the "static head" difficulties, which ought to flatten out their front into a chisel-like form. It will perhaps help our correspondent to realize why there should have been a particularly high "bore" in the Johnstown valley if we remind him that about half the bulk of the head of it was made up of trees, houses, rocks, stones, locomotives, thistledown and other like bodies in an almost inextricable mass, so that the first seen of the flood by those below was not water, but a mass of dancing houses and timber. It is therefore pretty hard to say where the "bottom retardation" of such a mass would begin and end.—ED. ENG. NEWS.]

The Flow from the Ponce de Leon Artesian Well.

35 BROADWAY, NEW YORK, July 30, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

In your issue of July 27th, there appeared a communication from Mr. A. de CARADEUC, of Charleston, S. C. referring to your article upon the Ponce de Leon artesian well which depended for its data upon my diary kept during the progress of the work.

Mr. de CARADEUC marvels at the "enormous yield of water" through a "bottom diameter of 5 ins.," but when, after a more careful examination of the article he criticises, he sees that from top to bottom the well is 12 ins. in diameter, and that nowhere in that article is the dimension "5 ins." spoken of, he will no doubt withdraw his incredulity. His assumed "velocity of 1¼ miles per minute" being thus reduced to less than ¼ mile per minute will bring my statement of a flow of 10,000,000 of gallons in 24 hours within the field of consistency.

I feel very much indebted, however, to Mr. CARADEUC for affording me the opportunity of explaining about the irregularity with which the temperature increases in the great well, for it will doubtless strike others as it does him that there may be something wrong in the record.

Your correspondent notices that the most abrupt change in temperature occurs between 35 ft. and 170 ft. deep, the increase being 1° for every 11 ft. The cause of this is that the water at 35 ft. which gave the 62° F. was surface water; and separated from this by 90 ft. of impermeable clay the water at 170 ft. which gave 74° F. was artesian water whose connection is uninterrupted to 510 ft. and perhaps by a dip in the porous stratum to even a still greater depth.

I had foreseen this condition, and before and during the drilling had hoped that it might have been our good fortune to penetrate to water of a temperature much higher than any we encountered at any point below 500 ft. The loss of the drill, under circumstances impossible to recover it, unfortunately put an end to this exceedingly interesting exploration.

The work of drilling the Ponce de Leon well was prosecuted with the most careful regard to the collection of scientific data, and I sincerely hope that your editorial remarks upon Mr. CARADEUC'S paper, which, probably through inadvertence, would bear the construction of supporting an inference of error in the record, will be rectified if this hurried letter shall convince you that they require it. WILLIAM KENNISH.

[We must plead guilty, with our original correspondent, in not reading our own article closely enough to detect the error in the diameter of the well. We somehow had the impression that the bore was reduced at the bottom, as is a very general custom. Mr. KENNISH'S correction of this oversight reduces the "phenomenal velocity" to reasonable proportions.—ED. ENG. NEWS.]

Concrete Mixing.

ALTOONA, Pa., August 20, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

I have always supposed that concrete is a mixture of small stones or pieces of broken brick, with or without a proportion of clean, screened gravel, wet, and hydraulic cement mortar; and that it is necessary to carefully mix the mortar before adding the broken stone, etc.

Is it proper to accept as good concrete a mixture made by shoveling into concrete-mixing machine dry cement, dry sand, and dry stones, and gravel? The machine, of course, being supplied with water by a pipe from the city main.

Your opinion on this subject will be looked for with a great deal of interest.

Very truly yours,
HARVEY LINTON,
City Engineer.

(There are various types of concrete mixing machines, and the efficiency of the concrete product depends much upon the manner in which its component parts are delivered to the machine. Good concrete can be made by first spreading out the stone—well washed—on a platform in the proper proportion, then covering this layer with other layers of the proper amount of gravel, sand, and cement, and finally shoveling this mixture, relatively dry, into the concrete mixer, where it receives the water requisite to make a concrete. Other machines first make a cement mortar to which the stone, etc., is added, and while the most troublesome this seems the safest plan. As the difference in bulk between the component parts is very great, we should expect a prejudicial separation of these parts if the material were placed in the mixer without the preliminary proportioning of parts referred to above. The stone in concrete is simply an inert

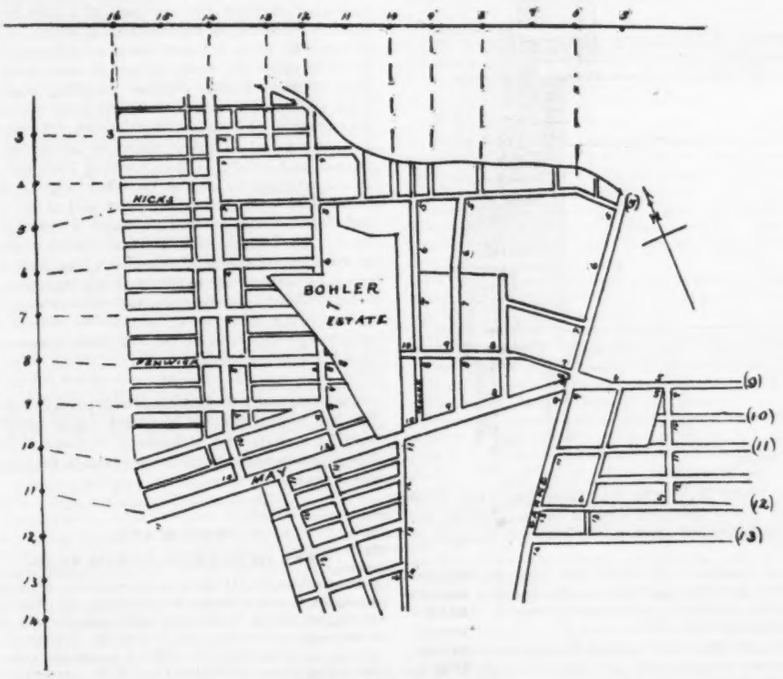
mass added to increase the bulk, and unless the cement mortar which binds this stone together is properly proportioned in its parts of sand, cement, and water, the concrete is valueless. With a tumbling-box mixer, the agitation can be kept up until every particle of stone is well covered with good mortar; but with the screw-mixer, the stroke is limited, and care must be taken to fairly well proportion the dry ingredients before delivery to the machine. The act of shoveling still further mixes the material.—ED. ENG. NEWS.)

House Numbering.

Department of Public Works,
CHICAGO, Aug. 13, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Having given some attention to the street numbering question lately, I send a sketch of my idea of numbering your Georgia correspondent's plat. I am a victim of erroneous numbering, hence I think that it is a subject which requires more attention than it generally receives. Irregularly laid out towns are of course difficult to number reasonably, but generally there will be found some streets which run parallel, and the numbers should be so divided as to bring such numbers as 1,000 or 1,100 1,500 or 1,600 at such streets, for instance, Moore Avenue and the Western Street in his plat, or Hicks Street and some street south if possible. There should be plenty of numbers, so that every family could have one, as for instance parties living above stores who have stairways down to a street door, also those living in the rear who have a front entrance.



House Numbering.

In Chicago 20 ft. is given to a number; this in decimally numbered streets gives the first house 300 and the last about 338, leaving 22 numbers unused and obliging parties using half stores to number in fractions and those upstairs to designate themselves as 328 Flat B. I would advise using the whole fifty numbers, giving a number to each 8, 10, or 12 ft. This would complicate affairs in the Atlas, but only one number need be put on each 20 ft. and parties with only one doorway could use either of the two numbers belonging to him. What does any one care if the next house is two even numbers off instead of one odd? Neither do I see any harm in leaving out 100 numbers if there is any object in it, any more than one number. It is impossible to have the numbers run consecutively. Buildings are not there or cover too much frontage, but every lot should have enough numbers to cover any reasonable numbers of entrances. A 25-ft. lot would then have enough numbers for a three-story building.

As an example of numbering, I would say that in a suburb of the city the City Engineer of the place said there were no 25-ft. lots and established 26 ft. for a number. We own four stores and two entrances occupying 100 ft. This is six front doors for eight parties, and they are entitled to less than four numbers.

ROBT. P. BROWN.

The Harbor of Bilbao.

PHILADELPHIA, Aug. 19, 1889

TO THE EDITOR OF ENGINEERING NEWS:

I am glad to learn, from the letter published in your issue of August 17, that MM. SHERMERHORN and D'AURIA are making some headway in their study of the improvements of the harbor of Bilbao. In his letter of May 24th, Mr. SHERMERHORN says: "We found no single concave jetty in the business, nothing but the commonplace, work-a-day parallel rectilinear jetties." But two months later, on July 29, Mr. D'AURIA writes: "I have now discovered a foot-note, etc. . . . from which I apprehend that Mr. MARICHAL'S estimate of the middle ordinate of the jetty is correct enough at 82 ft." This is a real progress. The rectilinear jetty has already a middle ordinate of 82 ft.

Mr. D'AURIA adds: "But can anybody from this infer what the curvature of the jetty really is?" I would answer that I was criticised for having used the expression "concave," instead of "rectilinear," and wanted simply to convince your readers as well as the author of the criticism that the jetty was not a rectilinear one and I have succeeded, I think, since Mr. D'AURIA says that "the jetty is represented by an arc of circle of only 15°."

Your correspondent also says that "it seems strange I should try to bring out as a prominent feature what is considered by Mr. DE CORDEMOY to be the most unimportant one, viz., the curvature of the jetty." I will answer that Mr. DE CORDEMOY agrees that the study of the harbor, made by Mr. ERAINTE DE CHURRUCA, must be considered as a model ("Memoirs of the Society of Civil Engineers of Paris," Dec. 88, p. 873,) and on page 876 we find the reason given by the engineer DE CHURRUCA for adopting the plan, which, according to Mr. DE CORDEMOY, has been successful.

1. The force of the current will be better protected by the proposed extension.

2. The concave form will help to maintain said force.

3. The channel being protected against the prevailing winds by this jetty, the tendency to keep to the left will encounter less resistance.

4. The sand embankments on the right side will help to keep the current along the jetty.

As can be seen from the above, the engineer had faith in the effects of the curvature.

"It seems strange" that Mr. D'AURIA should have such antipathy against the curved form, and should try to make us believe, according to circumstances, that the works have been successful or have not been successful. In fact, his synopsis, published in your issue of June 1, page 508, conveys the idea that the works have not been a success, and his comments in your issue of August 17, page 158, induce us to believe that it was a success.

Yours respectfully,

ARTHUR MARICHAL.

Metric Field Work Tables.

BUENOS AYRES, June 14, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

In your issue of April 20, I see an inquiry from "J. L.," Aguas Calientes, Mexico, asking for tables adapted to field work for metrical measures. When in Peru, 1871 to 1876 inclusive, I found the necessity of preparing some such tables for personal convenience. I have now been here some five years, engaged in railway surveys and construction, and have added to those before prepared from time to time, and at the urgent solicitation of many of my friends, who have valued them sufficiently to copy them, I am now having them set up in type and stereotyped, having arranged with a publishing house for an interest in the sales of the Spanish edition. A French engineer has offered to put it in French and have it published in France, and give me an interest, assuring me that the plan of the book is so simple, and will be so acceptable there, that a good circulation can be expected. I have been asked to have an English edition issued, but I am doubtful whether in Spanish-American countries and Brazil there would be demand enough to justify it. Engineers going to those countries for employment soon learn enough of the language to understand any text-book they ought to use.

As a matter of curiosity, I have bought every Spanish, French, Portuguese, and German book I could find bearing on the subject, and I find them very bulky with useless matter, and lacking a great deal of the useful, so that such a book as I have prepared has the coast somewhat clear.

There will be about 70 to 75 pages of new tables, aside from those of logs., sines, cos., tangs., etc., my idea being to come as near 150 pp. as possible and not exceed 200.

I would like to know your opinion on such a work in English. It is very true that the American table books can be used by dividing the functions of a 100 chord by 5, for a chord of 20, but that is not always convenient, and is sometimes laborious. Truly yours,

JOHN MCGEE

[We have grave doubts whether a translation of such a work into English would pay, for the various reasons suggested by our correspondent, but there will probably be considerable demand for it in Spanish and French, and many of our readers will be glad to know it is in preparation.—ED. ENG. NEWS.]

A Problem in Construction.

PHILADELPHIA, Aug. 14, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

I enclose a tracing of a plan for a twin sewer outlet now under contract upon which I would ask either your own editorial comment or that of some of your many readers. To make the case more clear, I would state that this outlet sewer occupies a slip about 230 ft. long and 45 ft. wide, leaving a space of about 10 ft. on the north and 5 ft. on the south between the outside of the sidewalls of the sewer and the adjoining docks. The slip itself is filled at the inner end with a pretty hard sedimentary deposit washed down by an old sewer emptying at that point; the lower two-thirds of the length of the slip is covered with 6 or 7 ft. of very soft mud lying on a very compact gravel.

The piles shown are (barely) driven into this gravel and are cut off at the extreme low tide; they have an average length of about 15 ft. The plan calls for a filling of earth around these piles up to the bottom of the timber platform, and a close row of piles to be driven across the mouth or river end of the slip. But the adjoining wharves are built on piles and the tide is free to circulate through them, and, in time, to wash away the material under the platform. In fact, although at one time filled to the top of the piles, vacancies 6 ft. deep now exist under the platform. The plan shows no provision for confining the earth in place about the piles.

The questions which I would submit to you and to your readers are these:—Is this safe construction under the conditions given? Is not the load on the center row of piles excessive when it is considered that the earth filling about piles may be, and actually is, removed? As the side walls of partly rubble and brick masonry must act as retaining walls, what do you think of their section? What would happen to this sewer outlet, supported on 5 piles per lineal yard, scarcely penetrating the hard gravel, and unbraced, if the adjoining private wharves were for any reason temporarily or permanently removed? What is to prevent the sewer platform from yielding laterally under any unequal side thrust?

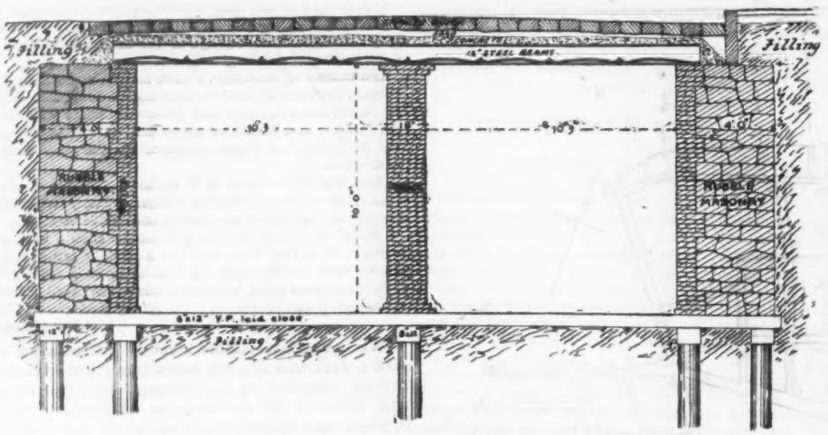
Yours respectfully,

P. R. F.

[We have heard of this sewer before (we think) from another source. But wherever it is, we most certainly cannot approve of its construction under the surrounding conditions mentioned by our correspondent. The designer has apparently forgotten hat water weighs nearly half as much as the mas-

onry; and with any vacancy under the floor, the sewer, when running full at a low tide, would at least severely try a 10-ft. span of timber only 6 ins. deep. The weight of one of the side walls just about equals the weight of the water alone on the center pile; and while one wall supported by two piles only carries a quarter of the load of the roadway and traffic, the center sing e pile carries one-half of it, or twice as much. As there is no provision for confining the earth under the floor, and thus allowing it to become compact, the earth cannot be assumed as giving any reliable support, and it is only safe to throw it out in figuring on stability, especially as this filling would be water-soaked.

As to the side walls, it would have been much better to have made them thinner at the top and wider at the bottom by stepping off the back of the wall. The height of the back filling shown seems to be about 14 ft. above the platform, and for this height of possibly wet material a total bottom



Plan for Sewer Outlet.

width of 4 ft. is insufficient for a compound wall of rubble masonry faced with brick.

As to stability, in our opinion, the entire structure would topple over on the slightest provocation from a side thrust, even if the adjoining wharves were not removed. The five piles, with their toes only resting on a very hard stratum and standing in very soft mud and water, would have practically no lateral stability at all. They would be free to revolve on the toe, and the uneven side filling of 10 ft. and 5 ft. mentioned, might alone be sufficient to give the starting push. We would expect an absolute wreck to immediately follow the removal of one of the adjoining wharves.

It would be well to remark here, in connection with the load on these piles, that it is not simply a question of a quiescent load. Judging from its cross-section, this sewer must drain a very considerable area, and the velocity of discharge during low water would probably be great. Under these conditions, there is a vibration in the masonry and a wave shock, especially if the brickwork is at all rough, that has a very considerable effect on the foundation, and one that must be provided for by giving it an additional amount of stability.

This is a case where the table should be made to stand on its own legs, and there should be at least twice as many legs under it to safely carry the load placed upon it, the outer rows being driven at an angle to act as braces. With only 15 ft. of soft mud under the floor, it appears that a hollow crib, filled in with solid material, would be still better. Either would hold the load safely, and hold it independent of any support from adjoining properties under the control of other parties. A work of this character is supposed to last indefinitely, and parsimony in the foundations supporting an expensive structure is the worst of all kinds of alleged economy. The design of the foundation is simply absurd; and in this special case it is only charitable to suppose that the designer failed to give it the necessary study or assumed conditions that did not exist.—ED. ENG. NEWS.]

Notes and Queries.

U. S. L., J. F. H., and others. Your inquiries as to Mr. WELLINGTON'S forthcoming "Manual of Railway and Field-Work" are answered on our editorial page. The matter you wish to use will appear late in October.

A correspondent wishes to know about "a small pamphlet published in the interest of vitrified sewer-pipe for water-works conduits, and where there is low pressure." Where can it be had? Send a copy to this office.

PERSONAL.

Mr. HARRY S. IVES, Superintendent of the Breckinridge Division of the Manitoba R. R., has been appointed General Manager of the Montana Central.

Mr. M. B. SHOAT has been appointed Auditor of the Rome, Watertown & Ogdensburg Ry., vice Mr. C. L. MARTIN, resigned.

Mr. JACOB A. HARMAN, C. E., formerly of Watseka, Ill., has removed to Glenwood Springs, Col., where he has formed a partnership with J. C. KENNEDY, C. E.

Mr. J. C. HOW, of Bath, Me., has accepted the position of Superintendent of the Janesville, Wis., Water-Works, vice Mr. T. T. CROFT.

Mr. JOHN W. CLARK has been appointed Road-master of the Chicago & Western Indiana Railroad, and the Belt Railway of Chicago, vice Mr. JOHN P. DOOM, resigned.

Mr. CHARLES B. STROKIN has been elected Vice-President and Superintendent of the Southern Kansas & Texas Ry., vice Mr. J. J. MULLANE, resigned. His office is at Panhandle City, Tex.

Mr. H. M. BRITTON, General Manager of the Rome, Watertown & Ogdensburg Ry., died at Oswego, N. Y., on Aug. 10. When the road was purchased in 1883 from the Sloan management, Mr. BRITTON became the General Manager.

Mr. E. J. REMILLION, Superintendent of the Kansas City Switch & Frog Works, died at Kansas City, Mo., Aug. 9. He was the inventor of the patent three-throw switch manufactured by the company.

Mr. TAYLOR WILLIAMS has resigned the position of General Superintendent of the Athens & Tellico R. R. to accept the general agency at Chattanooga, for the Chattanooga, Rome & Columbus.

Mr. OTTO MILLER has been appointed Superintendent of the Galena Division of the Chicago & Northwestern in place of Mr. CHARLES MURRAY. Mr. LUKE WHEELER has been appointed Assistant Superintendent at Galena.

Mr. HORACE SEE, for many years Chief Engineer and Naval Architect with Wm. Cramp & Sons, of Philadelphia, is about to open an office in New York, as consulting engineer on naval architecture. Mr. SEE designed the *Vesuvius*, the *Atalanta*, the *Monmouth*, and many other vessels which have made this Philadelphia shipbuilding firm named famous.

Mr. GEORGE LAIDLAW, one of the foremost Canadian railway builders, died recently at his farm at Balsam Lake, near St. Thomas, Ont. "Mr. LAIDLAW was the promoter of the Credit Valley scheme, which was to connect St. Thomas directly with Toronto. So wholly without funds was he in the inception of this project that he had to go to London, England, and obtain his rails on credit in the face of the strong opposition of the Grand Trunk People. All through this effort he sunk money, and would have lost all he had in it if it had not been for the fairness of Sir GEORGE STEPHEN, who received his proposal to make the Credit Valley Railway a part of the main line of the C. P. R. His friend, Mr. OSLER, of the firm of Osler & Hammond, assisted him in this effort to utilize the enterprise of the municipalities in voting bonuses to open up the central portions of Ontario, and therefore bring into play competition with the Grand Trunk. Many of the benefits we are now enjoying have resulted from this arrangement. Mr. LAIDLAW was born near Inverness, Scotland."—St. Thomas (Ont.) *Times*.

THE WIDTH OF ROADS, as built under the feudal system in France, was determined in a curious manner. If these roads connected two villages on the same feudal estate they belonged to the lord. If they passed from one estate to another, or connected distant cities, they were usually the property of the most powerful nobleman, who was the liege lord or suzerain, and he was obliged to keep them in order and protect those who traveled on them from robbers. Their width was determined as follows:—When the road was laid out a horseman, carrying a lance placed crosswise on the front of his saddle, went first over the route. Its width and the removal of trees or other obstructions on either side was fixed by the length of the lance. The roads connecting two villages were to be wide enough to permit the passage of a cart with a woman wearing a mantle and a white veil on either side of it. A road from a village into the country must be wide enough to permit the passage of two women abreast carrying a pitcher. That which led to private property must permit the easy passage of two beasts of burden. A crossroad need only be of sufficient width to allow two dogs to pass each other. Other roads of local use, such as those going to the mills, the churches or the public fountains, belonged to the lord of the estate, but only foreigners were obliged to pay toll on them. The custom of collecting tolls on roads and at bridges begins at this period. The lord being the only person able to build them, they could not exist without his assistance, and there was not any special injustice in permitting him to compel those who used them to help pay for their construction and for keeping them in order.

THE CALUMET & HECLA MINING CO. is contemplating a plan for an increased water supply by sinking a shaft and tunnelling to Lake Superior. The estimated cost is $20,000 per month for the next three years.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Pennsylvania.—B. M. & J. F. SHANLEY, of Newark, N. J., have the contract for building the Waverly & New York Bay R. R., by which this company will obtain a through freight line into New York. Construction is already in progress. An effort is being made to have the Waynesburg & Washington R. R. extended from Waynesburg, Pa., to the Mount Morris oil fields.

Ohio Valley.—The Nashville Northern R. R. Co., has been chartered in the interest of this company to build a railway from Nashville, Tenn., north to Princeton, Ky. The object of the road is mainly to develop the mines along the route.

Washington City & Point Lookout.—This company has been reorganized and a new board of directors elected. WM. J. BEST, of New York, is General Manager and superintendent of construction. The company was incorporated to build a railway from Washington City to Point Lookout, Md., 80 miles, but only 12¼ miles, from Hyattsville to Shepherd, Md., were constructed. It is announced that a syndicate of New York capitalists have taken hold of the enterprise and will complete the road as originally projected. The road is now leased by the Baltimore & Ohio R. R. Co.

Au Sable & Northwestern.—JAMES F. WILSON, of Potts, Oscoda county, Mich., Chief Engineer, has sent us the following information concerning this enterprise:

This road is projected to run from Au Sable, Mich., via Potts, to Hillman, Montmorency county, Mich., a distance of 55 miles, and has been completed and is in operation from Au Sable to within 3 miles of Potts, a distance of 35 miles. About one-half of the work was very light, with easy grades and curves, and the remainder is heavy. The road is built in the interest of the Potts Salt & Lumber Co., of Detroit, Mich., and will depend mainly upon the local freight and lumber traffic for business. A portion of the line from Potts to Hillman has been surveyed. The work of construction was done mainly by the company, with JAS. F. WILSON, Chief Engineer, in charge.

Baltimore & Ohio.—Work is being rapidly pushed on the branch from Roselle, N. J., to the Kill von Kull bridge and Staten Island. All the tracks have been laid on the Kill von Kull bridge, and the Staten Island shore, is ready for the trains. About 6 miles of track remain to be laid in New Jersey. It is expected that the road will be in operation by Oct. 1.——It is announced that a branch from Gaithersburg to Seneca, Md., is under consideration.

Grand Rapids & Indiana.—Engineers are at work surveying a route for the proposed extension of the Missaukee branch to Lake City, Mich.

Shepaug, Litchfield & Northern.—The projected branch from New Preston to Lake Waramaug seems likely to fall through for a lack of funds. The subscriptions lack $2,500 of the required amount.

Vaudreuil & Prescott.—Twenty-seven bids were received for the construction of the first section of this road, from Vaudreuil 20 miles west.

Evansville & Terre Haute.— It is stated that the Evansville & Richmond R. R. will be pushed rapidly through to Rushville, and a line be built from Rushville to Anderson, Ind., where this road will connect with the Cincinnati, Wabash & Michigan R. R., which has recently been purchased by the MACKEY syndicate.

Canadian Pacific.—Work is being pushed night and day on the line from London to Windsor, Ont., and it is expected to have it completed by Jan. 1, 1890.——It is stated that the proposed branch from Woodstock to Fort Erie, Ont., will be pushed rapidly to completion.

Western Maryland.—It is announced that work will soon commence on the proposed line of the Baltimore & Harrisburg R. R., from Porter's Siding to York, Pa., a distance of about 14 miles.

Philadelphia & Reading.—A report is in circulation that this company will soon have a through line to Pittsburg, Pa. The plan is to extend the Harrisburg & Potomac R. R. from Bowmandale east to a connection with the Philadelphia & Reading at the Susquehanna river, giving the Philadelphia & Reading a through line to Shippensburg, where connection is made with the Western Maryland R. R.; and using the tracks of the Western Maryland and the Baltimore & Ohio railways into Pittsburg.——The line from Rupert to Bloomsburg, Pa., has been completed and is now in operation.——The Philadelphia & Seashore Short Line R. R. Co. has been incorporated in New Jersey to build the branch from Winslow Junction to Cape May, N. J.

Flint & Pere Marquette.—We have received the following information from WILLIAM B. SEARS, of East Saginaw, Chief Engineer, concerning the Saginaw, and East Saginaw belt line:

The road runs from the Jackson, Lansing & Saginaw R. R. junction south and east to a connection with the old line, a distance of 8.12 miles. It was completed and opened for traffic June 20, 1889. There is one bridge across the Saginaw river and bayou. The work was done by the company, with FRED TITTMANN, of East Saginaw, in charge. The object of the road is to open up the various lumber, salt, and other manufactories along the route.

Lehigh Valley.—Right of way agents are reported at work securing the land for the right of way of the proposed line from Geneva to Buffalo, N. Y.

Pennsylvania, Poughkeepsie & Boston.—This road is now completed south from Portland, Pa., to Bender's Station on the Lehigh & Lackawanna R. R., and tracklaying is being pushed on toward Slatington, Pa., where connection will be made with the State Valley line, which will be rebuilt, and the line ultimately continued to Harrisburg, Pa. The bridge over the Delaware river at Portland is nearly completed, and that over the Lehigh river at Slatington is well under way.

Old Colony.—Surveys are in progress for a line from South Framingham to Boston, Mass., a distance of 22 miles. The object of the branch is to obtain an independent line from Fitchburg to Boston, instead of running over the Boston & Albany R. R.

Baltimore & Delaware Bay.—This road has been completed, and was opened for traffic Aug. 19. It runs from Chestertown, Md., to Bombay Hook, Del., thence the cars are transferred across the Delaware river to Bayside, N. J., where connection is made with the Central R. R. of New Jersey. The line from Chestertown to Clayton, 32 miles, which was built some time ago, has been entirely reconstructed, and a new line built from Clayton to Bombay Hook, 9 miles. The object of the road is to give a short line from the peach-growing country in Maryland to New York.

Detroit, Charlvoix & Escanaba.— The contracts have been let for this road, which is projected to run from Mackinaw City, Mich., via Charlvoix, Mich., to Harrison station on the Flint & Pere Marquette R. R.

Indiana & Lake Michigan.—The contract for the first 10 miles from St. Joseph, Mich., south, has been let to Joseph Donagoe, of St. Paul, Minn. to be completed Sept. 15. The next 12 miles, which will bring the road to Galien, Mich., has been let to Hazel Green, to be completed, ready for tracklaying, by Sept. 30. C. C. King & Bros., have the contract for 6 miles south of Galien, to be graded ready for tracklaying Sept. 30. Some trouble is being had in securing the right-of-way for the remaining 12 miles to South Bend, Ind., and as soon as this is settled the contract will be let. It is thought that the line is an extension of the Logansport division of Terre Haute & Indianapolis R. R.

Lime Rock.—This road which encircles the city of Rockland, Me., a distance of about 9 miles, is nearly completed. The object of the road is to open up the numerous limestone quarries around Rockland. A large amount of trestle has been constructed. Two locomotives and 200 cars are employed. PARKER SPOFFARD of Bucksport, Me., was the engineer in charge of contruction.

Canada & St. Louis.—This road has been sold at foreclosure to HENRY A. GARDNER, of Chicago, who is said to represent a syndicate of Chicago capitalists controlling the Chicago & Eastern Illinois and the Chicago & West Michigan railways. The purchase price was $225,000. The road was originally intended to run from Bay City, Mich., to Danville, Ill., and has been completed from Goshen, Ind., to Battle Creek, Mich., 68 miles, and from Bay City to Midland, Mich., 18 miles. It is thought that the line will be completed by the purchasers.

Zanesville & Ohio.—This company, which defaulted Aug. 1, on the interest on $2,000,000 of bonds, has been reorganized with a new Board of Directors. C. M. WICKER, of New York, is President.

Projects and Surveys.

Lansing & Northwestern.—QUINCY A. THOMAS, of Oxford, Mich., Chief Engineer has sent us the following data:

This road is projected to run from Lansing, via Dewitt St. Johns, Maple Rapids, and Chippewa lake, to Charlevoix, Mich., a distance of 200 miles. The preliminary survey has been made for the entire line and about one-half of the location completed. The maximum grade is 40 ft. per mile and the maximum curve is 4°. The road passes through a rich agricultural country in the south and enters the extensive forests of northern Michigan. The principal business of the road will be in agricultural products, timber, and passenger traffic. Work has just been commenced securing right of way and other local aid. The contract for building the first section of 30 miles from Lansing to Maple Rapids, Mich., will be let about Oct. 1. The company was incorporated in July, 1889, ARTHUR A. BEMENT, of Lansing, is President.

United States Central.—At a meeting of the projectors of the Worcester & Hartford R. R. recently held, the name of the road was changed to the above, and the following officers elected: President and General Manager, JOHN GILMAN, of Worcester, Mass.; Vice-President, SAMUEL FITCH, of Rockville, Mass.; Secretary and Treasurer, GEO. P. LADD, of Spencer, Mass. The road is projected to run from Worcester, Mass., to Hartford, Ct.

McKeesport & Duquesne.—Incorporated in Pennsylvania to build a railway from McKeesport south along the Monongahela river, a distance of 2 miles. Among the incorporators are: J. C. SMITH, E. F. WOOD, and A. S. WEDDELL, of McKeesport.

Logansport & Indianapolis.—A project is on foot to build a line of railway from Logansport, Ind., to Indianapolis, Ind., a distance of 62 miles.

Georges Valley.— At a recent meeting the following directors were elected: J. C. THURSTON, E. L. THOMPSON, A. F. BROWN, J. M. ROBBINS, and E. H. BURKETT, of Union, Me., and JOEL HILLS, of Warren, and W. W. CASE, of Rockland, Me. The road is projected to run from Augusta to Warren, Me., 40 miles.

Palisades.—This scheme to build a railway from Weehawken ferry to the top of the Palisades and thence north through Fort Lee, Closter, Englewood, and Alpine to Pierpont mountain is being revived. It is estimated that the cost of construction will be about $500,000.

Troy & Averill Park.—About $75,000 has been subscribed in aid of this proposed road by the towns along the route. JOHN MCLAREN, of West Sandlake, N. Y., is interested.

Rye Beach.—A bill has passed the New Hampshire Legislature incorporating the Rye Beach R. R. Co.

Reading & Boyerstown.—A project is on foot to build a railway from Reading, Pa., via Stony Creek and Friedensburg, to Boyerstown, Pa., a distance of about 15 miles. LEWIS KRAMER, of Stony Creek, Pa., is at the head of the enterprise.

SOUTHERN.--Existing Roads.

Albemarle & Pantigo.—H. T. GREENLEAF, of Lee's Mills, N. C., Chief Engineer, sends us the following:

This road is projected to run from Mackey's Ferry to Pantigo, a distance of 30 miles. The country through which the line runs is level, affording easy grades and curves. The principal business of the road will be in grain, cotton and lumber. The John L. Roper Lumber Co., of Norfolk, Va., has the contract, and about 200 men are now at work on the line. About 16 miles of track have been laid, and it is expected to have the road completed by Jan. 1, 1890. H. T. GREENLEAF is in charge of construction.

South Brunswick Terminal.—The entire line of this road from South Brunswick to Waynesville, Ga., has been cleared and 9 miles out of the 16 graded. Steel rails for the entire distance are on the ground, and tracklaying began Aug. 15, at Waynesville. It is expected to have the road completed by Sept. 15. JOHN I. HOLLY, of New York, is President.

Cincinnati, Alabama & Atlantic.—Work has commenced on this line between Huntsville, Ala., and Tullahoma, Tenn., 64 miles, under Chief Engineer O. H. P. CORNELL, of Tullahoma. T. B. Carpenter & Co., of Tullahoma, has the contract for furnishing the cross-ties.

Kentucky Midland.—The right of way has now been all obtained between Paris and Georgetown, Ky., and the road will be completed by the last of September.

Columbus Southern.—Track has been laid from Columbus, Ga., south to Bull creek, a distance of 3 miles, and as soon as the temporary bridge across the creek is completed tracklaying will be pushed rapidly ahead. W. S. GREEN, of Columbus, is Chief Engineer.

Central R. R. of Georgia.— Surveyors are now at work on the locating surveys for the proposed extension from Greenville to Newnan, Ga. Work on the widening of the track from Columbus to Newnan, is well under way.

Louisville Southern.—Tracklaying has been completed from Lexington, Ky., to the Tyrone bridge and as soon as this bridge is completed the road will be put in operation from Lawrenceburg to Lexington, Ky., 24 miles.

Louisville & Nashville.—This company has a large force of men at work completing its line through the Cumberland Gap tunnel and trains will be running soon. ——The report is again in circulation that work will commence immediately on the branch to Tuscaloosa, Ala.

Kentucky Union.—This road has been completed and is in operation from Winchester to Orlando, Ky., and it is expected that the entire line will be in operation by the close of the year.

Middleburg, Highland & Lake Butler.—GEO. A CHALKER, of Middleburg, Fla., Secretary, sends us the following data:

This road is projected to run from Middleburg to Highland, Fla., and thence toward Lake Butler. About 12 miles of the line have been completed, and are now in operation as a lumber road. The work is generally light. There is one trestle 300-ft. long over Black creek. The road will do a general freight and passenger traffic business when completed. JAS. A. BRYAN is President, and MATT. DEKLE, of Middleburg, is Chief Engineer.

Monongahela River.—About 2,000 men are now at work grading this West Virginia road and building the coke ovens to be developed in connection with the road. The road will run from Fairmount to Clarksburg, W. Va., a distance of 35 miles.

Cincinnati, Selma & Mobile—An effort is being made to raise the funds necessary to build the gap from Marion Junction to Hamburg and the extension from Akron, Ala., to Aberdeen, Miss., 80 miles.

Carolina, Knoxville & Western.—At a meeting of the stockholders of this company recently held, the following officers were re-elected: President, J. B. HUMBERT, Princeton, S. C.; Vice-Presidents, S. J. MCKINNEY, and T. N. COOPER, and Secretary and Treasurer, A. D. BYRD, Greenville, S. C. The company now has 105 miles of road graded, from Augusta, Ga., to Greenville, S. C., and also 20 miles graded from Greenville north toward Knoxville. Fourteen miles of the 20 from Greenville north are now in operation. The remainder of the line through the mountains to Knoxville, Tenn., will be heavy and expensive work. There will be one long tunnel on this division. Negotiations are now in progress for the completion of the line, and it is believed that the road will be built in the near future.

Tennessee & Coosa River.—This road has been sold to a syndicate of capitalists, who, it is stated, will build the extension from Atalla to Huntsville, Ala., 85 miles. The road is to be completed by Jan. 1, 1890.

Ohio & Big Sandy.—It is reported that this company recently chartered to operate the Chattaroi R. R. will extend it 100 miles.

Paducah & Tennessee.—H. H. Coombs, of St. Louis, Mo., who has the contract for building the first section of this road, has already commenced work. The road is to run from Paducah, Ky., to Paris, Tenn., a distance of 95 miles. THOS. H. PURYEAR, of Paducah, is President.

Staunton & West Augusta.—The contract for building this road, which is projected to run from Staunton, Va., to the Dora coal fields, 25 miles, has been let to the Keating Co., of Reading, Pa. Work is to commence in 30 days. Hill & Stout, 42 Broadway, New York, are the engineers.

Projects and Surveys.

Fayetteville & Albemarle.—D. G. MCDUFFIE, Chief Engineer, has commenced the survey for this proposed North Carolina road.

Walterboro & Yemassee.—A company is to be organized in South Carolina to build a line of railway from Walterboro to a connection with the South Carolina R. R., at Pregnall's Station, a distance of 20 miles.

St. Albans & Coal River.— The projectors of this West Virginia road are making efforts to secure the money necessary to build the line. The districts of Jefferson and Washington have been asked to vote $23,000 in aid of the road and a meeting will be held at St. Albans, W. Va., Sept. 7, to vote $7,000 in addition to the $23,000 already voted. JOHN S. CUNNINGHAM, of St. Albans, is interested.

Athens & Barnett Shoals.—Surveys are in progress for a railway to run from Athens to Barnett Shoals, Ga.

Georgia.— The bill to incorporate the Dahlonega & Dawsonville and the Dalton & Stephenson R. R. companies, and to continue in force the charter of the Augusta & Summerville R. R. Co., have been reported for first reading in the Georgia Legislature. The bill to incorporate the Artesian City R. R. Co. has been passed.

NORTHWEST.--Existing Roads.

Jacksonville Southeastern.—A press dispatch states that the grading for the branch from Litchfield, Ill., to St. Louis, Mo., will commence soon, and it is hoped to have the extension completed by Jan. 1.

Burlington & Missouri River.—Tracklaying is being pushed on the branch to the Wyoming coal fields. The road is now completed to Marshland in Leonard precinct.

Winona & Southwestern.—Surveyors are now locat-

ing this line from Bear Creek Station southwest, and the right-of-way agents have begun condemnatory proceedings to secure the remaining portions of the right-of-way in the towns of Norton and Leeds, Minn. It is expected that about 15 miles of road will be built this year.

Port Arthur, Duluth & Western.—The contract for building this railway from Port Arthur to a connection with the Duluth & Iron Range R. R., a distance of 84 miles, has been let to Conmee & Middleton for the sum of $1,500,000. The road will run through a rich mining district, and the principal business will be the transportation of ore. It is expected that about 40 miles of the line will be completed this year.

Pacific Short Line. The city of North Platte, Neb., has offered this company a subsidy of $100,000 on condition that the line be built through that town. The contracts for the construction of the second section of 110 miles from Plainview, Neb., west will be let soon.

Ohio & Mississippi.—Press dispatches state that surveyors are now at work on the old survey from Shawneetown, Ill., to Paducah, Ky., a distance of about 50 miles.

Union Pacific.—This company has filed chattel mortgages aggregating $655,000 on its rolling stock and equipments. The mortgage is given to the American Loan & Trust Co., of New York. The third parties to the transaction are the New York Locomotive Works, $36,000; the Michigan Car Co., $139,000; the Peninsular Car Co., $311,000; Wells & French Co., $4,000; Rhode Island Locomotive Works, $95,000, and the St. Charles Car Co., $68,000.

Abbottsford & Northeastern. About 400 men are now at work grading this road between Abbottsford and Black River Falls, Wis. It is expected to have this portion of the line completed by Oct. 15.

Duluth, Red Wing & Southern.—It is announced that arrangements have been made whereby the money necessary to complete this road can be obtained. It is thought that the early completion of the line to Duluth is probable.

Chicago, Rock Island & Pacific.—The Metropolitan Trust Co., has brought suit against this company as lessee of the Chicago, Kansas & Nebraska R. R. asking for the foreclosure of a mortgage of $25,000,000 given by the C., K. & N., to secure money for the construction and equipment of the line. Interest on the bonds due Jan. 1, and July 1, 1889, amounting to $1,200,000 remains unpaid.

Projects and Surveys.

Midland Pacific.—S. L. TATE, President of this company is quoted as saying that work will be commenced next spring on its proposed road, which is projected to run from Sioux Falls, Dak., to Puget Sound, a distance of 1,500 miles. Surveys are now in progress.

Milbank, Egan & Sioux City.—It is announced that C. B. DORE, of Minneapolis, Minn., has been appointed Chief Engineer of this road, and that surveys will commence at once, looking forward to the early construction of the road. WM. BROOKS, of Brookins, Dak., is President.

Escanaba & Crystal Falls.—The building of this road, a notice of which was given in our issue of last week, is only a part of a plan to develop the mines of the Menominee range, which have recently been purchased by the Bleichroder syndicate of Berlin, through their agent, FERDINAND SCHLESINGER, of Milwaukee, Wis. The plan is to build the railway from Escanaba, Mich., to Crystal Falls, Mich., 90 miles, and to construct 12 steel steam ships. Contracts for four of these ships have already been let; the ships to be delivered July 1, 1890. By this time it is expected to have the road ready for the rails. The total cost of the improvements is quoted at $5,000,000.

Marquette & Dead River.—A project is on foot to build a railway from Marquette, Mich., to the Dead river pine district. The road will operated as a logging road only for the present.

SOUTHWEST.—Existing Roads.

Mississippi River & Bonne Terre.—J. H. SERVISS, of Bonne Terre, Mo., Chief Engineer, writes us that 15 miles of track have been laid on this Missouri road, and that tracklaying is now in progress. It is expected that the road will be opened for traffic by October. There will be one tunnel 250 ft. long, and two combination Pratt truss bridges of 125-ft. and 135-ft. span respectively.

Kansas City, Wyandotte & Northwestern.—Kilpatrick Bros. & Collins, who have the contract for building the Kansas City & Beatrice R. R., running from Summerfield to Beatrice, Neb., have commenced work. The road is to be completed in 40 days.

St. Louis & San Francisco.—The people of West Plains and Howell county, Mo., are trying to induce this company to build an extension of the Salem branch from Salem, Mo., to West Plains, Mo.

Projects and Surveys.

Omaha, Kingman & El Paso.—A railway company by this name has been incorporated in Kansas. Among the incorporators are: G. A. WALKUP, of Hutchinson, and J. D. HUMPHREYS and W. M. WALLACE, of Kingman.

ROCKY MT. AND PACIFIC.—Existing Roads.

Northern Pacific.—Tracklaying is completed on the Gallatin-Butte branch to within 2 miles of Willow creek and 7 miles west of Three Forks.—It is announced that work will soon commence on the branch from Boulder to Elkhorn, Mont., 21 miles, and the line be completed within 3 months.

Denver & Rio Grande.—Contracts will soon be let for building the road to the summit of Pike's Peak, several bids having already been received. The road will be 9.75 miles long.—Amended articles of incorporation have been filed providing for the building of a branch line from Petersburg, Colo., via the military post to Golden, Black Hawk, and Central City, Colo.

Atchison, Topeka & Santa Fe.—A report is in circulation that this company is considering building a branch from Trinidad, Colo., up the north fork of the Las Animas river. The object of the road is to gain access to the coal fields in that vicinity.

St. Paul, Minneapolis & Manitoba.—It is announced that work will be begun at once upon the railway from Great Falls, Mont., southeast to the Belt mountain mining districts. A rumor is in circulation that the main line will be extended to Spokane Falls, W. T., in the near future.

Bellingham Bay Ry. & Navigation Co.—It is announced that Bennett, Larabee & Co., of Portland, Ore., have taken the contract for building this line, which is projected to run from Seattle, W. T., to a connection with the new Westminster Southern R. R., at the International boundary. The road is to be in operation by Jan. 1, 1891.

Spokane Falls & Northern.—Tracklayers on this road have reached a point beyond Dragoon creek, a distance of 41 miles from Spokane Falls, W. T. It is expected that track will be laid as far as Colville, W. T., by Sept. 10. D. C. CORBIN, of Spokane Falls, is at the head of the enterprise.

Projects and Surveys.

Montana & Wyoming.—Incorporated in Montana to build a line of railway from Billings, Mont. to and across the Yellowstone river, near the mouth of Clark's Fork, thence through the Crow Indian reservation, to Cook City, Wyo., with a branch from the main line up Bear creek to the Park county coal mines. Among the incorporators are: ELIJAH SMITH, E. R. BELL, and PROSPER W. SMITH, of New York.

Pasco, Goldendale & Columbia Valley.—The Columbia Valley & Goldendale R. R. Co. has filed supplementary articles of incorporation changing its name as above. The road is projected to run from Pasco, W. T. to Vancouver, W. T.

Grant's Pass & Coast.—Incorporated in Oregon to build a railway from Grant's Pass to the southern boundary of Oregon. Among the incorporators are: J. T. FLYNN, HARRY YOUNG, and ARTHUR CONKLIN.

Road Canon.—The incorporators of this Colorado company are: C. F. MEEK, CHAS. WHEELER, E. T. WELLS, WM. J. EVANS, and E. F. ARTHUR.

Pacific.—A railway company by this name has been incorporated to build a line of railway from San Francisco, Cal., to Santa Cruz, Cal. Surveys are now in progress. The object of the road is to open up the timber lands along the route.

Seattle Southern.—The surveys for this road have been nearly completed from Seattle, W. T., to Portland, Ore., and the plans and profiles are now being made. A very favorable line, is said to have been secured.

RAPID TRANSIT.

Street Railways.—***New York, N. Y.***—The Broadway Surface Ry. will be sold at auction at the Real Estate Exchange on Aug. 30, together with its franchises, plant and property.

Glenshaw, Pa.—The Glenshaw Street Ry. Co. has been incorporated to build a line between Allegheny and Glenshaw. The incorporators are J. F. KEIL, G. W. WILLIAMS, C. VAN BUREN, Jr., and P. W. SEIBERT, of Pittsburg, and A. KENNEDY, of Allegheny.

Piqua, O.—The Piqua Street Ry. Co. has been incorporated. Capital stock, $75,000.

Waycross, Ga.—The Waycross Street Ry. Co. will operate its line with steam motors.

Hurley, Wis.—A street railway between Hurley and Ironwood is projected by Dr. MCLEOD, S. S. CURRY, and J. D. DAY.

Topeka, Kan.—The Topeka Rapid Transit Ry. Co. has been organized.

San Antonio, Tex.—The San Antonio Land & Improvement Co. and the Cross Town Ry. Co. will build street railways to the fair grounds.

Cable Railways.—***San Diego, Cal.***—The San Diego Cable Ry. Co. has awarded a contract for 100,000 lbs. of iron work to the Coronado Foundry Co., of San Diego.

St. Louis, Mo.—The St. Louis Cable & Western Ry. Co. is reported to have failed.

Elevated Railway.—***St. Louis, Mo.***—Mr. BONZANO, of the Phœnix Iron Works, Phœnixville, Pa., is Chief Engineer of the new elevated railway, and is having plans made for the structure.

Cable Grip.—The Continental Cable Way & Grip Co. has been incorporated at St. Louis, Mo., by M. M. BROADWELL, of Kansas City; S. H. TERRY, of St. Louis; R. W NESBET, of San Francisco, and others. Capital stock, $1,000,000. It will operate the Terry system of cable railway and grip.

Electric Railways.—***Easton, Pa.***—The Pennsylvania Motor Co. will rebuild the electric line.

Braddock, Pa.—The Braddock Street Ry. Co. has been incorporated to build an electric road. Capital stock, $80,000.

Washington, D. C.—Capt. A. A. THOMAS, President of the Brightwood Ry. Co., has decided to make a trial with a Julien storage battery car on the new line on Seventh St. The car was built by John Stephenson, New York.

Lexington, Ky.—The Lexington City Ry. Co. will apply to the next Legislature for an amendment to its charter permitting the use of electric traction.

Nashville, Tenn.—The City Electric Ry. Co. will build 2 miles of extension, making a total length of 5 miles, and will put on 8 cars. Engines, boilers and electric plant will be needed.—The Citizens' Rapid Transit Co. has been organized by W. H. MITCHELL, W. S. JONES W. B. ROOD, and others; the line will be operated by electricity.

Rochester, O.—The street railway company will extend its line 3.7 miles, through West Bridgeport, Beaver and Vanport, and will adopt electric traction.

Ottawa, Ill.—The Ottawa Electric Street Ry. Co. opened its road for traffic on Aug. 15. There are 6 miles of track.

Winona, Minn.—The Winona City Ry. Co. has applied to the city for power to operate its road by electricity.

Niagara, Ont.—The St. Catharine's, Niagara & Port Dalhousie Street Ry. Co. has been organized to build an electric line. President, Capt. P. LARKIN.

HIGHWAYS.

South Carolina Roads.—A meeting of road overseers was held recently at Chester, S. C. The present road law was read and discussed. In the general discussions the following points were brought out: The minimum of time, 3 days, was not given to the roads; a road is no better than its worst part, and hence the importance of keeping each section in condition; each overseer should subdivide his hands into squads, putting the larger squads at the worst places; an overseer with more hands than he needs should send some of them to a neighboring overseer with less hands or a worse road; commissioners, overseers, and people are all entitled to blame for the present bad condition of the roads; the average time allotted to each road is not more than a good day's work per annum; the majority opposed a road tax; the majority opposed the purchase by the county of shovels, to be worn out by overseers and their neighbors in farm work—let the hands furnish their tools; a certain piece of road, conveniently located, might be worked up to a highly scientific standard for the overseers to pattern after; long steel scrapers, on double-foot plough stocks, could be used with advantage as substitutes for shovels; mules might be hired as well as men in large numbers; too many little bridges were charged up to the county that overseers should put up without expenditure of cash; complete blanks and records should be kept of the whole service; rock culverts might be used instead of many bridges.

New Jersey Roads.—The following bids for macadamizing St. George's Ave., from Elizabeth to Rahway, have been received by the freeholders of Union Co., at Elizabeth, N. J.: B. M. & J. F. Shanley, Newark N. J., 35 cts. per cu. yd. for earth excavation, $1.09 and $1 30 for telford paving; C. F. Mairs, 48 Dey St., New York, 26 cts. for earth excavation $1.18 for macadamizing; Wm. H. Adams, New York, 23 cts. for earth excavation, 49 cts. per sq. yd. for macadamizing, 40 and 46 cts. per sq. yd. for telford paving; Wm. Chamberlain, Rahway, N. J., 39 cts. for earth excavation, $2 for rock, $1 for loose rock, 50 cts. per cu. yd. for excavation of bridge pits, drains, and pipes, 30 cts. per cu. yd. for embankment, 99 cts. and $1.19 for macadam.

Indiana Roads.—Six townships in Hancock County voted on the gravel road question, Aug. 13, and the majority of the votes were for free roads. This will practically make every road in the county free. The three precincts in Greenfield gave a majority of 241 in favor of free roads.

Huntsville, Ala.—The County Commissioners have awarded $100,000 of the 5 per cent. county turnpike bonds to P. H. Vennor & Co., of New York, at a premium of $385 and accrued interest. The remaining $50,000 of said bonds will be sold at the discretion of the Commissioners as the money is needed.

CONTRACTING.

Harbor Work.—The contract for the completion of the harbor works at Midland, Ont., has been awarded to Robert Reed, of Owen Sound, Ont., his being the lowest of the 8 bids.

Railway Grading.—The contract for grading 4½ miles of railway from Yankton, So. Dak., to the works of the Western Portland Cement Co. has been let to M. T. Woolley and Michael O'Neill, of Yankton, for 8.8 cts. per cu. yd. for earth in embankment, and the same for

waste, including 1,000 ft. haul. There will be about 45,000 cu. yds. moved.

Beams and Girders.—The following proposals for materials for the Congressional Library building have been received by BERNARD R. GREEN, Engineer and Superintendent, Washington, D. C.: Rolled iron beams Carnegie, Phipps & Co., Pittsburg, Pa., 2.85 cts. per lb.; New Jersey Steel & Iron Works, Trenton, N. J., 2.85 cts. —Girders and beams: Dearborn Foundry Co., Chicago, Ill., 3½ cts. per lb. for plate girders, 3.4 cts. per lb. for connected iron beams; New Jersey Steel & Iron Co. Trenton, N. J., 2.85 cts. and 3.13 cts.; J. E Buddington, New Haven, Conn., 3.69 cts. and 3.49 cts.; Snead & Co. Iron Works, Louisville, Ky., 3⅛ cts. and 3½ cts.; Carnegie, Phipps & Co., Pittsburg, Pa., 2.85 cts. for girder, 3.15 cts. for 96,492 lbs. or 2.95 cts. for 85,901 lbs. for beams. Both contracts were awarded to the New Jersey Steel & Iron Co., its sections being more economical for the strength of the floor in view.

Cross Ties.—Proposals for cross-ties have been received by ALFRED F. SEARS, Engineer of the Metropolitan Railway Co., Portland, Ore. The road is 4 ft. 8½ ins. gauge, laid with T rails weighing 30 lbs. per yd. It will be operated by electric motors, the cars with maximum load weighing 8 tons The ties were to be sawed, in the city they are to be 6 ft. x 6 ins. x 6 ins., spaced 2 ft. apart c. to c.; in the suburban district they are to be 8 ft. long. Yellow and red fir only was admitted, and if the ties were hewed, the dimensions given were to represent heart and thickness. The bids for short ties ranged from 17 cts. to 26 cts., averaging 19.8 cts. per tie; the bids for long ties ranged from 20 to 26 cts., and averaged 23.6 cts. per tie. The contract was let to Davis Bros., at 17 cts. and 20 cts. respectively.

New Croton Aqueduct.—The contract for cast-iron pipe and specials, to be delivered at Shaft No. 24, has been awarded to the McNeal Pipe & Foundry Co. at $3,100.

Dams.—The only bids received by the Board of Public Works, Milwaukee, Wis., for constructing a dam on the river was from J. H Kearney: 5,000 cu. yds. of earth excavation, $1.60; 100 cu. yds. of rock excavation, $6; 3,280 cu yds. of concrete, $6; 337 cu. yds. of rubble masonry, $6; 3,290 cu. yds. of coursed masonry, $14; 419 cu. yds. of dimension stone, $30; total, $90,004.

Stone.—The following proposals have been received by the Docks Commissioners, New York City: About 900 cu. yds. of cobble stone: John A. Bouker, 95 cts. per cu. yd.; Brown & Fleming, 95 cts.; Daniel Donovan, $1. The contract was awarded to J. A. Bouker. About 1,700 cu. yds. of riprap stone: Brown & Fleming, 58 cts. per cu. yd.; John A. Bouker, 70 cts.; D. E. Donovan, 80 cts.; Alexander J. Howell, 80 cts. The contract was awarded to Brown & Fleming. About 600 cu. yds. of broken stone: Hudson River Broken Stone & Supply Co., $1 65 per cu. yd.; D. E. Donovan, $1.69; John A. Bouker, $1.73; Brown & Fleming, $1.82; A. J. Howell, $1.90. The contract was awarded to the Hudson River Broken Stone & Supply Co.

Building.—The contract for the Soldiers' Home building at Hot Springs, Dak., has been awarded to W. H. H. Turneaure, of Mitchell, Dak., at $34,724.

Street Work.—*Memphis, Tenn.*—The total cost for the two sections of brick paving on E. Court St. was $2.90 and $2.91⅞ per sq. yd.; $2.83⅞ and $3.76¼ per sq. yd. exclusive of granite, stone curbing, and sidewalk.

Le Sueur, Minn.—The following proposals have been received for grading Tyrone Hill; about 5,000 cu. yds. of earth to be moved, average haul about 1,500 ft.: Brown of Minneapolis, 16¾ cts. per cu. yd.; Curtis, of Le Sueur, 17 cts.; Sullivan, of Mankato, 17 cts.; Wegran, of Henderson, 22 cts.; Walsh, of Le Sueur, 22½ cts.

Kansas City, Mo.—The only bid received by the Board of Public Works for brick paving was from Geo. A. Johnston, $2.13¾ per sq. yd. for McKim brick.—Contracts for curbing have been awarded as follows: B. A. Seitz, 76 cts. per lin. ft.: Southern Sandstone Co., 63½ cts.; Nathan Edens, 60, 63, and 64½ cts., 15 cts. for resetting, 20 cts. for redressing; M. Walsh, 66 cts.; M. V. Lyle, 62 and 63 cts., 12 cts. for resetting; T. J. Ellis, 65 cts., 14 cts. for resetting.

Omaha, Neb.—The contract has been signed for the paving of Bristol St., with Galesburg brick. The brick will be put on a concrete base, and the contract price was $2.14 per sq. yd.

Toronto, Ont.—The two proposals received for asphalt paving on Sherbourne St. were as follows: No. 1: Asphalt, per sq. yd., $2.80; granite setts, per sq. yd., $3.70; stone curbing (straight), per lin. ft., 90 cts.; stone curbing (circular), $1.35 lin. ft. No. 2: For the same items respectively was $2.47, $3.94, 82 cts., $1, $1.50.—Contracts for block paving have been awarded to Ardagh & Leonard, A. W. Godson, W. Jones, James Rogers, and A. Van Vlack.—A contract for stone curbing was let to A. J. Brown at 85 cts. per lin. ft. for circular curb, 48 cts. per lin. ft. for gutter stones.

PROPOSALS OPEN.

Sewers.—Estimated cost, $13,000. THE BOARD OF PUBLIC WORKS, Houston, Tex.

Dredging.—About 8,000 cu. yds. of material between Congress St. and railway bridges, Troy; 15,000 cu. yds. between railway bridge and sloop lock, Troy; 9,000 cu yds. at Cuyler Light, and 7,000 cu. yds. more or less, at Bogart Light. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y., August 27.

Reservoir.—Completion of reservoir now partly built. A. SHINKLE, President of Reservoir Trustees, Covington, Ky. August 27.

Sewer.—In Amity St. WM. P. CONE, Street Commissioner, Hartford, Conn. August 28.

Street Works.—Grading, curbing and paving. THE BOARD OF POLICE COMMISSIONERS, Memphis, Tenn. August 29.

Building.—Boiler house at the county farm. R. B. EASTMAN, architect. THE COUNTY FARM COMMITTEE, Kings County Court House, Brooklyn, N. Y. August 29.

Railway.—Grading and masonry for 6 miles of third track. WM. H. BROWN, Chief Engineer, Philadelphia, Wilmington & Baltimore Ry., 233 South 4th St., Philadelphia, Pa. August 30.

Bridge and Canal Work.—Canal bridges at Lockport, Rochester, and Rome; water-power machinery for bridges at Clyde and Brockport; improving Canandaigua Lake harbor; canal walls at Ilion and Oswego. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. August 30.

Dredging.—In Sabine river. Capt. W. L. FISH, U. S. Engineer Office, New Orleans, La. August 31.

Bridge.—Wooden bridge, 30-ft. span. FRANK J O'FLAHERTY, County Surveyor, Kansas City, Mo. September 3.

Sewer.—Vitrified pipe sewer, 12 and 15-in.; Ys and lampholes. T. J. LANAHAN, Clerk of Board of Contract, Albany, N. Y. September 3.

Water-Works.—THE WATER-WORKS COMMITTEE, La Grande, Ore. September 4.

Dock.—Extending dock. Lieut. CHAS. B. WHEELER, A. Q. M., U. S. A., Fort Schuyler, N. Y. September 4.

Artesian Well.—F. L. CLISBY, Village Clerk, Parker, So. Dak. September 9.

Street Work.—Grading, curbing, brick or block paving. R. R. MARBLE, City Engineer, Columbus, O. September 9.

Wharf.—Reconstructing wharf, with iron piling. A. J. PERRY, Asst. Q. M. Gen., U. S. A., San Francisco, Cal. September 11.

Sewers.—In the 31st St. sewer district. F. B. CROCKER, President of Board of Public Works, Denver, Col. September 14.

MANUFACTURING AND TECHNICAL.

A Dredge Boat is wanted for a contract for cleaning a canal. Box 1, Gretna, La.

Excavation.—The Union Mills Paper Co., of Lambertville, N. J., has about 2,000 cu. yds. of rock excavation to be done, or will hire 8 steam drills and 4 derricks and hoisters.

Locomotives.—The Rhode Island Locomotive Works, of Providence, R. I., have turned out a new engine for the New York & New England Ry.

The Canadian Locomotive & Engine Co., of Kingston, Ont., has shipped 2 mogul engines weighing 49 tons and 2 eight-wheel engines weighing 43 tons, to the Northern Pacific & Manitoba; 2 moguls to the Quebec & Lake St. John, and 3 eight-wheel engines to the New Brunswick.

Cars.—The Pullman Palace Car Co., of Chicago, is building 2 complete trains of parlor and sleeping cars for the Louisville, New Albany & Chicago.

The Litchfield Car & Machine Co., of Litchfield, Ill., is building cars for the San Diego & Eastern and the Quincy & Keokuk.

The Indianapolis Car Works, of Indianapolis, Ind., have an order for 500 box cars for the Missouri, Kansas & Texas.

The Lima Car Works, of Lima, O., have an order for 500 freight cars for the Pennsylvania.

The St. Louis Car Co., of St. Louis, Mo., has an order for cars for the Lindell Street Ry.

Palace Cars.—The Palatial Car Co. has been incorporated at Portland, Me., to construct a patent car, which consists of a combination of sleeping car and parlor car, the berths being in the daytime in pockets under the floor, while at night they are quickly raised into position, the chairs taking their places in the pockets under the berth. It is the invention of L. J. HARRIS. Capital stock, $1,000. President, EDWIN F. PERKINS, of Boston; Vice-President and General Manager, LOUIE J. HARRIS, of Boston; Treasurer, ALBERT C. BURRAGE, of Boston; Secretary, LUTHER L. HARRIS, of Boston.

Pipe.—A contract has just been let to the National Tube Works Co., of McKeesport, by the Northwestern Ohio Gas Co. It is for 80 miles of large sized pipe for the projected line from the gas fields of northwestern Ohio to Detroit. Half of the line is to be of 12-in. and half of 16-in pipe, and the entire order will closely approximate $800,000.

Economy in Steam Plant.—The Chicago office of Westinghouse, Church, Kerr & Co. has made a good showing in the line of economy, in the plant for the Aurora Electric Light & Power Co., Aurora, Ill. The original plant consisted of a horizontal return tubular boiler with an automatic engine, heater, etc., burning the best quality of lump coal, which was found to be necessary under the conditions, at an average cost of from $4 to $5 per night. This plant was replaced by a Hazelton boiler fired by two Roney mechanical stokers and a Westinghouse compound condensing engine. The company purchased the cheapest quality of slack coal, and there was a large reduction in the quantity burned. The net result, running exactly the same number of lights and for the same time, is said to have been a reduction of from $4.50 per night to 90 cts. per night.

Gas Engines.—It is said that the largest gas engines in the country are in use at Raleigh, N. C., to drive the plant for the electric light system; they are 50 and 60 H. P.

Transmission of Steam Power.—The modern plan of subdividing steam power, or the primary transmission of power from the boiler to the work by means of steam pipes in place of belts and shafting, is growing in favor. Westinghouse, Church, Kerr & Co. make a specialty of this class of work, and have fitted up the plant of the Long Island railroad at East New York, using in place of a single engine, three engines of 75, 60, and 25 H. P. respectively.

Pipe Works.—The Chicago Hydraulic Pipe Co. has been organized to manufacture, lay, construct, and purchase and sell all kinds of pipe used for water, gas, and kindred purposes, to contract for and construct water-works and lease or sell the same, to contract for, construct, lease, and operate all kinds of systems for conveying water, gas, etc. Capital stock, $500,000. Incorporators, WILLIAM J. REEVE, ISRAEL P. RUMSEY, and GEORGE N. STONE.

Dredge Boats.—The International Dredge Co., of Washington, D. C., has been incorporated at Alexandria, Va., for the manufacture of dredging boats. DANIEL MCCONNELL, CHARLES W. MCGOWAN, JAMES E. CAMPBELL, JOHN FRASER, and GEO. W. CAMPBELL are the incorporators.

Meters.—The National Meter Co., of New York, reports 10,725 meters sold during the year ending July 1, making a total of 68,000.

Garbage Crematory.—The City Council has decided to build a second garbage and sewage crematory at a cost of $6,000.

The Reading Iron Co. has been incorporated by AUSTIN CORBIN, A. A. MCLEOD, of Philadelphia, GEO. F. BAER, SIMON SEYFERT, and GEO. E. CLYMER, of Reading, to carry on the business of the Reading Iron Works. Capital stock, $300,000.

Bessemer Iron.—Reports from Pittsburg state that Bessemer pig iron was advanced Aug. 15 from $15.50 and $16 per ton to $16.50 and $17 per ton. The advance was made in view of a prospective advance in coke and freight rates.

Car Works Burned.—The works of the Huntingdon Car Mfg. Co., of Huntingdon, Pa., have been destroyed by fire; 28 cars for the New York, Susquehanna & Western, and a number of valuable patterns were destroyed. The loss is about $30,000.

Pumps.—The new extensions being built by the San Antonio & Aransas Pass Ry. are being equipped with pumps, boilers, and tank valves, manufactured by the Laidlaw & Dunn Co., of Cincinnati, O.

Spikes and Rail Joints.—The Safety Spike & Rail Joint Co. has been organized at Washington, D. C., and will establish works at Birmingham, Ala. President, RALPH WALD; Secretary, H. T. STANTON.

Market Prices.—*Rails.*—New York and the East, $28. Pittsburg, $28 to $28.50. Chicago, $29 to $30 for standard weights, $33 to $34 for 30-lb. and $38 to $40 for 12-lb. and 20-lb; the demand for light iron rails continues fairly active, for immediate delivery it has become difficult to place orders, and mills are getting from $36 to $37, according to weight.

Track Material.—New York; splice bars, 1.85 to 1.90 cts., delivered; spikes, 1.95 to 2 cts.; bolts, 2.65 to 3 cts. Pittsburg; spikes have been advanced to 2.10 cts., 30 days. It is said they are likely to go still higher, as well as everything in this line, in view of the rise in raw material. Chicago; steel splice-bars, 1.90 cts. to 1.95 cts; iron splice-bars, 1.80 cts. to 1.85 cts.; spikes 1.95 cts. to 2 cts.; bolts, square nuts, 2.50 cts. to 2.55 cts.; hexagon, 2.60 cts. to 2.70 cts.

Car Works.—Robinson, Moore & Co. will remove their car works from Waterloo, Ia., to Minneapolis, and put up an extensive plant.

Pipe Coupling.—The Monumental Coupling Co. has been incorporated at Baltimore, Md., to manufacture pipe couplings under the patents of A. N. RANKIN, in which cold instead of hot metal is used.

Ventilation.—The Buffalo Forge Co. has put in a system of hoods and exhaust fans at the Barber asphalt works on Fourth St., Buffalo, N. Y., to carry off the smoke and gases which have been a nuisance to then eighborhood. The gases are carried to a special furnace, and the particles of sand, dust, etc., are deposited in a tank of water.

BRIDGES AND CANALS.

Bridge Notes—*Enosburg, Vt.*—The selectmen will build a bridge at Stoneville.

New Bedford, Mass.—The contract for the bridge over the Acushnet river at Coggeshall St. has been awarded by the County Commissioners to Brownell & Murkland, of New Bedford, at $49,000.—The contract for an iron bridge has been awarded to R. F. Hawkins & Co., of Springfield, at $20,000.

Westfield, Mass.—The contract for an iron bridge over Munn's brook has been awarded to R. F. Hawkins & Co., of Springfield, at $1,585.

Boston, Mass.—The proposals received by J. E. JONES, Superintendent of Streets, for the construction of the Byron St. bridge were as follows: Josiah Shaw, $3,448; W. H. Keyes, $3,722. The contract was awarded to Josiah Shaw.

Washington, D. C.—Thos. P. Morgan has the contract for placing rip-rap round the pier of the free bridge that was damaged by the flood.

Middleway, W. Va.—The following proposals for a Pratt truss highway bridge of 100 ft. span have been received by T. G. BAYLOR, C. E., Charlestown, W. Va.: Smith Bridge Co., Toledo, O., $1,795, 6 panels; King Iron Bridge & Mfg. Co., Cleveland, O., $1,850, 7 panels; Wrought Iron Bridge Co., Canton, O., $1,875, 7 panels; Penn Bridge Co., Beaver Falls Pa., $1,950. The contract was awarded to the King Iron Bridge & Mfg. Co.

Anderson, Ind.—The contract for a suspension bridge of 175 ft. span has been let to the Indiana Bridge Co., of Muncie, Ind.

South Haven, Mich.—The contract for an iron bridge has been awarded to the Smith Bridge Co., of Toledo, O., at $9,300.

Chicago, Ill.—The contract for a double roadway bridge at Adams St. has been awarded to the King Iron Bridge & Mfg. Co., of Cleveland, O. Riter & Conley, of Pittsburg, Pa., have the contract for a new iron bridge at Madison St. The contracts for masonry have been awarded to Fitzsimmons & Connell, of Chicago.

Duluth, Minn.—A bridge across the canal to Park Point is projected. A franchise for a railway and highway bridge was granted by the last Legislature.

St. Paul, Minn.—A bridge is to be built over the Omaha tracks at Burr St. It will be of iron, with stone piers; roadway 40 ft. wide, two sidewalks 10 ft. wide. It will cost about $50,000, of which the city will pay $12,000.

Danbury, Ia.—The contract for a combination bridge on wooden pile foundations has been awarded to A. G. Bayne & Co., of Minneapolis, Minn., at $2,450.

St. Charles, Mo.—Contracts for county bridges have been awarded to the Wrought Iron Bridge Co., of Canton, O., for the Elm Point bridge, and to Sammelman Bros. for the Dardenne bridge.

Kansas City, Kan.—The Interstate Pontoon Bridge Co. has been incorporated. Capital stock, $26,000. Directors: JOHN ARTHUR, E. A. BARRY, W. B. TAYLOR, A. R. FORD, DON MCCLAIN, W. A. PYLE, and J. J. REYNOLDS.

Kansas City, Mo.—The water company is building a new iron bridge to carry its pipes across the Kaw river, replacing the structure carried away some time ago. It will cost $30,000.

Nebraska City, Neb.—Surveys are being made for a highway bridge across the river.

Pueblo, Col.—The County Commissioners will build a new bridge across the Arkansas river.

Chehalis, W. T.—The following proposals for a bridge have been received by DAVID URQUHART, County Auditor: Pacific Bridge Co., Portland, Ore., $4,000; San Francisco Bridge Co. (branch at Seattle, W. T.), $4,000; J. D. Wardwick, Portland, Ore., $3,000; Hoffman & Bates, Portland, Ore., $2,980. The contract was awarded to Hoffman & Bates.

Fort Worth & Rio Grande Ry.—The Chicago Forge & Bolt Co. has the contract for six steel bridges between Granbury and Stephensville: Pratt trusses, one of 130 ft. span, one of 110 ft., two of 90 ft.; one lattice girder of 75 ft. and one plate girder of 60-ft. span. They are designed to carry two engines weighing 85 tons each, and all are carried on iron cylindrical piles filled with concrete.

Viaducts—*Pueblo, Col.*—The contract for the new steel viaduct has been awarded by the City Council to the Edge Moor Bridge Co., of Wilmington, Del., for $34,000.

Denison, Tex.—The viaduct to be built across the tracks of the Missouri, Kansas & Texas Ry. will cost about $24,000. The city appropriates $7,500. It will be 1,900 ft. long.

Cincinnati, O.—The following proposals have been received by the County Commissioners for bridges over the Cincinnati, Washington & Baltimore, and Cincinnati, Hamilton & Dayton railways, and over Mill creek; also for a viaduct connecting these over the valley between Garrard and State Aves., on the line of Liberty St. Superstructures of viaduct and bridges: Smith Bridge Co., Toledo, O., $65,700; Milwaukee Bridge Co., $69,217; Youngstown Bridge Co., Youngstown, O., $70,240; Queen City Bridge Co., Cincinnati, $73,206; King Iron Bridge & Mfg. Co., Cleveland, O., $73,480; F. J. P. Brackett Bridge Co., Cincinnati, $74,920; Variety Bridge Co., Cleveland, O., $76,595.90; Columbus Bridge Co., Columbus, O., $77,863. Keystone Bridge Co., Pittsburg, Pa., $79,645. Substructures: Thos. Moloney, Cincinnati, O., $18,331. Columbus Bridge Co., Columbus, O., $20,192.50; Richardson & Shipman, Portsmouth, O., $20,600.75; John Scully, Cincinnati, $20,054; F. W. Soelter, Cincinnati, $19,920; Foltz & Joute, Cincinnati, $22,703; Hinkle & Brahm, Cincinnati, $23,950; P. Muncy & Son, Cincinnati, $24,056.50; B. E. Scully, St. Louis, Mo., $22,035; John Sperry, Cincinnati, $27,923; Milwaukee Bridge Co., $29,664; R. G. Huston, Glendale, O., $29,782; M. Stopper, Cincinnati, $30,250. F. W. Soelter's bid was informal, and Thos. Moloney's was withdrawn; the contract was therefore awarded to John Scully. J. M. HARPER is County Engineer.

The St. Cloud Bridge Co. has been incorporated at St. Cloud, Minn., to build bridges, viaducts, etc. Capital stock, $50,000. The incorporators are C. F. MACDONALD, P. R. GRIEBLER, FRANK TOLMAN, DAVID T. CALHOUSE and A. F. ROBERTSON, all of St. Cloud.

Murray Canal.—The Murray canal, in Ontario, was opened Aug. 15.

ELECTRICAL.

Electric Light.—*Lynn, Mass.*—A contract for street lighting has been awarded to the Thomson-Houston Electric Co.

Middletown, N. Y.—The Middletown Electric Co. has been incorporated by FRANK P. SLADE, of Brooklyn, and A. M. TRAVERS, of Flatbush.

DuBois, Pa.—The DuBois Electric Light, Power & Heat Co., has been incorporated. Capital stock, $25,000.

Washington, D. C.—The District Commissioners have awarded a contract to the Electric Heat, Light & Power Co., of Pittsburg, for furnishing incandescent electric lights on certain streets.

Van Wert, O.—The Citizens' Electric Light & Power Co., has been incorporated. Capital stock, $20,000.

Columbus, Ind.—The Common Council is contemplating the purchase of a new electric light plant, to be maintained by the city. The present plant is run by a private corporation, and there is considerable complaint that it does not afford a satisfactory light.

Delevan, Ill.—It is proposed to put in an electric light plant.

Santa Fé, N. M.—A charter for an electric plant has been granted by the county authorities giving M. A. BREEDEN, of Santa Fé, JOSEPH MULHATTON, of Louisville, and A. W. MOREMAN, of Brandenburg, Ky., exclusive privileges for erecting and maintaining an electric light service in the city for 20 years. In consideration of this grant these parties agree not to charge any more than is now charged for gas, and will maintain free of charge 10 lights of 25 c. p. in the city for a period of 10 years. Work on the plant will begin at once, and the plant is to be in operation within 2 years.

Electric Light Companies.—The Thomson-Houston Electric Co. and the Fort Wayne Electric Co. have formed a business alliance, and $1,500,000 of the capital stock of the latter has been offered to stockholders of the former at $12.50 per share (par value $25).

Port Louis, Mauritius.—Sealed proposals for lighting the city of Port Louis, Mauritius, by gas or electricity, will be received by G. V. KHERN, Mayor. Tenders made by persons or companies established outside the Colony should be sent at least 15 days previous to the departure of the mail which leaves Marseilles on Oct. 1, to the National Provincial Bank of England at London; or to M. L. G. ADAM, 134 Boulevard Haussmann, at Paris, with a note, not sealed, giving the name and address of the bidder and sureties.

SEWERAGE AND MUNICIPAL.

Street Sprinkling.—The proposed plant for pumping and distributing sea water for street sprinkling at Oakland, Cal., is estimated to cost as follows: pumping works, $20,000; reservoir, $16,000; distribution system, $131,000; total, $167,000. The operating expenses and interest on cost of plant are estimated at $21,046 per annum.

Sewers.—*Central Falls, R. I.*—The contract for a brick sewer 24 to 48 ins. diameter has been awarded to Morley & O'Connell, of Boston.

Holley, N. Y.—The new Sewer Committee is having surveys made.

Bath, N. Y.—The village trustees have awarded to James I. Mills the contract for an 8-in. tile sewer in First St., the cost not to exceed 30 cts. per ft. A catch basin was ordered at the end of this sewer at a cost of $25.

Louisville, Ky.—An appropriation for $300,000 has been made for sewers, and the Sewer Committee has decided in what locations new sewers are to be built.

Gadsden, Ala.—The city has issued $40,000 for sewers and improvements.

St. Paul, Minn.—City Engineer RUNDLETT estimates the cost of the Midway sewerage system at $150,333.

Oakland, Cal.—The proposed sewer system is estimated to cost $828,063.

Fort Worth, Tex.—The Sewer Committee wants bids on 18 miles of sewer pipe.

Denison, Tex.—It is contemplated to issue $85,000 of bonds to build the sewerage system previously reported, and for permanent street improvements. For particulars address the mayor.

Montreal, Ont.—A number of new sewers are to be built. For particulars address P. W. ST. GEORGE, City Surveyor.

Bonds.—*Columbus, O.*—Proposals will be received until Sept. 4, by H. E. BRYAN, City Clerk, for $15,000 sewer bonds and $112,900 street improvement bonds.

St. Paul, Minn.—The following bids have been received for the city bond issue of $334,000, of which $250,000 is for sewerage purposes, $50,000 for hospital buildings and $34,000 for the general bridge fund. Farson, Leach & Co., Chicago, 3 6-100 per cent. premium, $345,290.40; S. A. Kean & Co., Chicago, 2 557-1000 per cent. premium, $343,200; Rialé Bros. & Co., Boston, 2 35-100 per cent. premium, $342,519; Brewster, Cobb & Co., Boston, 2 29-100 per cent. premium, $342,318.60; Adams, Blodgett & Co., 2 77-1000 per cent. premium, $335,595.18; R. L. Day & Co., Boston, 16-100 per cent. premium, $335,204.

Street Work.—*Exeter, N. H.*—During the next three years the city will spend $75,000 on the streets, principally in macadamizing.

Beverly, Mass.—The selectmen have awarded a sidewalk contract to Daniel Corkeny.

Buffalo, N. Y.—The following proposals for asphalt paving have been received by City Engineer MANN from the Barber Asphalt Paving Co.: For paving Austin St., 28 ft. wide, from the Erie canal to the Military Road, $29,415; Grant St., 32 ft. wide, from the Military Road to Forest Ave., $48,897; Auburn Ave., 30 ft. wide, from Niagara St. to Elmwood Ave. $56,034; California St. 28 ft. wide, from West Ave. to Herkimer St. $10,295. The Park Commissioners will lay asphalt paving on the Circle and the Bank.

Jackson, Mich.—The bids for paving Main St. were from John Streicher, of Toledo; the Warren-Scharf, Asphalt Paving Co., of New York; Nichols & Stevens, R. E. Emmons, T. C. Brooks, and W. B. Yates, and C. B. Hyde, of Jackson. The bids range from 90cts. per sq. yd. for cedar blocks to $3 for Medina stone.

WATER-WORKS.

NEW ENGLAND.

Sanford, Me.—Additional mains are being laid.

Skowhegan, Me.—Skowhegan Village Corporation has voted to rent 75 hydrants of the Skowhegan Water Co. at a yearly rental of $2,000, for a term of 20 years.

Portland, Me.—The City Council has granted the company an extension of time to Nov. 30, in which to complete the Munjoy reservoir.

Rochester, N. H.—An act has passed the Legislature authorizing the town to purchase the works from the water company.

Newport, N. H.—An act has passed the Legislature empowering the town to establish works, to be free from taxation for five years.—[The citizens are anxious to have works, and steps will probably be taken at once to establish them, the bill having been delayed in the Senate for some time.—ED.]

Springfield, Mass.—The Hyatt Pure Water Co., of New York, has made two propositions to the city to purify Ludlow water. One is to establish a 32-drum filtering plant for $105,000. The other includes the 32 drum filter and the erection of a stand-pipe, 20 ft. in diameter by 150 ft. high, through which the water would pass for aeration. This they offer to establish for $120,000.

North Adams, Mass.—About 2½ miles of mains have been laid. The new reservoir has been completed.

Avon, Mass.—Bids for constructing a supply well for a system of works were received on Aug. 23. L. E. HAWES, of Boston, is the engineer.

Riverside, Mass.—The Riverside Water Co. will soon organize under the provisions of the charter granted by the State Legislature last year. The officers will be: T. M. STOUGHTON, President; C. R. STOUGHTON, Secretary; H. A. LAMB, Treasurer; M. A. WARD, Superintendent.

Shelburne Falls, Mass.—Consulting Engineers CLEMENS HERSCHEL and D. H. TOWER have inspected the Sadawga reservoir, and in their report recommend the following improvements: To provide a wasteway, 2½ ft. high by 40 ft. long; raise the earth dams 3 ft., to be 10 ft. wide on top, with slopes of 2½ to 1 ft., both inside and outside. The reservoir has a drainage area of about 6 sq. miles.

MIDDLE.

Oneonta, N. Y.—The construction of a new 224,000-gall. reservoir will be commenced soon. JEHIAL VAUGHN, of Stamford, N. Y., has been awarded the contract. It will be supplied from an artesian well, which flows 60 galls. per minute.

Rouse's Point, N. Y.—At a recent election to vote on the question of constructing works, 74 ballots were cast for and 12 against the project. Work will begin immediately.

Clyde, N. Y.—The new stand-pipe has been satisfactorily tested.

West Troy, N. Y.—A new stand-pipe is to be erected.

Brooklyn, N. Y.—St. Johnland County Farm. The contract for building a retaining wall around the reservoir has been awarded to EDWARD FREEL, of Brooklyn, at $24,250.

Rochester, N. Y.—J. NELSON TUBBS, Chief Engineer, has submitted his report to the Common Council on the question of obtaining an additional supply of water. His leading conclusions we extract from the *Herald* of that city as follows:

That an immediate addition to our water supply is imperative; that Hemlock, Canadice, and Conesus lakes should be first exhausted as sources of that supply before going to lake Ontario; that Hemlock and Canadice lakes combined will furnish 28,000,000 galls. per day, which would be sufficient for the present needed supply; that, therefore, the plan recommended by the experts for an immediate resort to Conesus lake should not be adopted; that the combined pumping and gravity plan previously recommended by the chief engineer is preferable to the gravity plan, pure and simple, and that it can be constructed at an initial cost of $400,000 less than any other system, and, considering everything, is the cheapest as well as the safest and most convenient yet proposed; that under no circumstances should the Holly system for the suppression of fires be abandoned; that a general system of metering all the water furnished to consumers cannot be depended upon to prevent or postpone the imminent danger of a scarcity of water; and that any proposed plans for an increased supply of water should include an item for increased reservoir storage capacity.

Carthage, N. Y.—Works are projected. Address the Town Clerk.

Perry, N. Y.—A company will probably be organized and works established.

Kingston, Pa.—Bids were received on Aug. 23 for trenching, laying, and back-filling 2¼ miles of 10-in. pipe, 5¾ miles of 20-in. pipe, and one section of 24 in. pipe, from Kingston to a point designated on Spring Brook, by L. A. WATRES, Secretary, at the office of L. D. SHOEMAKER, Wilkes Barre, Pa.—[Notice of proposals open was published in our last issue.—ED.]

Cumberland, Md.—A small amount of extensions is being made. The City Clerk has been authorized to advertise for supplies for the ensuing year.

Centreville, Md.—Work has recently been commenced on the new water supply system. The town commissioners will build the works. The Constructing Engineer is R. A. CAIRNES, of New York. A filter bed will be located in Gravel Run meadow, at the northern end of the town. A stand-pipe will also be erected.

Baltimore, Md.—Large mains are to be laid to convey water from the pumping station, to be erected on Oliver and Ann Sts., to the new Guilford reservoirs.

SOUTH ATLANTIC AND SOUTH CENTRA

Hampton, Va.—A 400,000-gall. stand-pipe is to be erected.

Gordonsville, Va.—The contract for building works has been awarded to JOHN JACOBY, of Bridgeport, Conn., at $8,840. The other bidders were: J. A. Cogan, Alexandria, Pa.; F. D. Weane & Co., Philadelphia, Pa., Glamorgan Works, Lynchburg, Va.; J. C. Goodlon Albermarle Co., Va.

Boston, Mass.—The following bids for constructing a dam at Lake Cochituate were opened on Aug. 5:

Bidders.	All per cu. yd.							25,800 ft. B. M spruce lumber	Total.
	2,000 cu. yds. earth excava'n	104 cu. yds. clay puddle	475 cu. yds. stone masonry	600 cu. yds. concrete	122 cu. yds. block paving	300 cu. yds. dry rubble paving	5 cu. yds. brick masonry		
Moulton & Mahony, Lawrence, Mass	$2.90	$3.60	$24	$6.60	$24	$9 60	$24	$72	$29,320
C. W. Parker, Rockford, Mass.....	4	5	21	6	19	9	20	26	27,883
Thomas A. Rowe, Newton, Mass....	2.50	2	24	7	20	8.25	10	35	30,676

Franklin, N. Y.—GEO. STILSON, Secretary Board of Water Commissioners, informs us that the contract for building works has been awarded to JEHIAL VAUGHN, of Stamford, N. Y. The specifications call for 17 hydrants, six 6-in. and two 4-in. valves, and about 7,000 ft. of pipe.

Islip, L. I., N. Y.—The Great South Bay Water Co., of Bay Shore, L. I., N. Y., was incorporated at Albany, N. Y., on Aug. 19. The officers are: President, JOHN LOCKWOOD; Secretary, DANIEL VAN ALLEN; Treasurer, JOHN C. LOCKWOOD. The company has obtained the franchise to build works for the town of Islip, L. I., and proposes taking water to supply the eastern portion of the town, comprising Bayport and Sayville, from the Patchogue works. The western portion, comprising Islip and Bay Shore to Babylon, will be supplied from wells sunk at Bay Shore. This plant will comprise two 1,000,000-gall. pumping engines. About 25 miles of cast-iron pipe will be laid, 200 hydrants set, and one stand-pipe erected at Bay Shore. The hydrant rental is $6,000 per year for 20 years.—[This franchise has been granted under the new law passed by the State of New York, approved June 5, 1889, which we publish in another column.—ED.]

Tarrytown, N. Y.—Proposals for furnishing the following material, trenching and pipe laying, will be received by SAMUEL B. LEACH, Engineer, Aug. 28:

Cast-iron pipe, 2,800 ft., 4 ins.; 8,500 ft., 6 ins. Quantities of hydrants, valves and special castings not specified. Trenching and laying about 8,000 ft., 4 ins., and 10,000 ft., 6 ins.

Medina, N. Y.—S. E. FILKINS, Chairman Water Committee, sends us the following:

Works are about to be constructed upon the franchise plan. Correspondence with contractors is solicited by the Water-Works Committee. No plans have been adopted, and no contracts let.

St. Johnland, L. I., N. Y.—Sealed proposals will be received until Aug. 29 for furnishing the labor and material for erecting a boiler-house on the county farm by the Committee on County Farm, Room 13, County Court House, Brooklyn, N. Y.

David's Island, N. Y.—The New Rochelle (N. Y.) Water Co. has been awarded a contract to supply the town with water from Echo bay. CHAS. W. HUNT is Engineer and General Manager.

Edgewater, S. I., N. Y.—The Board of Trustees has authorized the Crystal Water Co. to place 25 additional fire hydrants within the village limits.

Camden, N. J.—The Board of Health has pronounced the water supply unfit for use, and Inspector LECKNER is to present a plan to the Water Committee of the City Council, by which he thinks an ample supply of pure water can be procured, without great additional expense.

New Brunswick, N. J.—By a recent analysis of the domestic supply, it was discovered that the water is impregnated with vegetation and sediment, and unfit for use.

Chambersburg, Pa.—A new 1,000,000-gall. reserv oir is to be constructed.

Wilmington, N. C.—The supply is to be increased by an 8-in. artesian well. It is now 520 ft. deep.

Cordele, Ga.—Works are projected. Address J. D. SHIPP.

Madison, Ga.—Address the Madison Improvement Co. for information regarding the proposed works.

Key West, Fla.—The city has contracted with the Shickle, Harrison & Howard Iron Co., of St. Louis, for sinking an artesian well.

Sheffield, Ala.—MINOR SCOVEL, President of the Scovel & Irwin Construction Co., of Nashville, Tenn. sends us the following:

The Sheffield Land Co., the original owner of the town site, spent $30,000 on a temporary system. To meet the demands of the rapid growth of the town, the company has been granted a 30 years franchise for new works. They have awarded a contract for works to cost $250,000 when complete, to the Scovel & Irwin Construction Co., The supply will be pumped from the Tennessee River to a stand-pipe, 20 ft. in diameter by 80 ft. high. The city will pay $50 each for 120 hydrants.

Chattanooga, Tenn.—It is reported that works costing $30,000 are to be constructed in Tunnel Hill, a suburban town.

North Knoxville, Tenn.—The citizens are in favor of artesian wells as the source for their proposed works.

Richmond, Ky.—W. B. SMITH writes to ask if we cannot send him the name of some reliable contractor who will take a contract to build works for the Richmond Water-Works Co. The estimated cost is $75,000. Population, 5,000.

Hopkinsville, Ky.—The contract for constructing works has been awarded to A. KENNEDY, of Rockport, Ind., at $65,000. The Western Kentucky Insane Asylum will be supplied from these works.

NORTH CENTRAL

East Palestine, O.—Bids for furnishing approximately the following material and machinery, as well as labor for constructing works, will be received on Sept. 2, by ENOS GOBLE, Chairman Water-Works Committee: Cast-iron pipe, 98 ft., 12 in.; 1,000 ft. 10 in.; 6,360 ft. 8 in.; 4,700 ft. 6 in.; 7,600 ft., 4 in. Specials, about 8 tons. Hydrants, 36. Valves, 26, 10 to 4-in Valve boxes, 26. One pump house; one or two pumping engines of 750,000 galls. capacity; one or two tubular boilers. Also constructing one brick-lined reservoir of 300,000 galls. capacity.

Terre Haute, Ind.—The county commissioners have contracted with the company to furnish water for the court house and jail for $1,200 per year.

Danville, Ind.—THOMAS J. COFER, GEORGE W. RICHARD, ISAAC PIERSOL, a d WM. DAGGY have been appointed by the Town Council to ascertain the cost of laying mains. The Town Council has granted a franchise to the Danville Gas Co., allowing it the privilege of setting 30 hydrants within the city limits, agreeing to pay $4,200 per annum.

Port Huron, Mich.—The Common Council has instructed the Water Board to have the mains extended to the fair grounds.

Three Rivers, Mich.—The wells recently sunk are furnishing an abundant supply.

Owosso, Mich.—A special election will be held on Sept. 2, to vote on the question of bonding the city for $15,000 for additional mains.

Portland, Mich.—The Village Council has contracted with an Eastern Syndicate to construct works. M. H. FOND, of Grand Rapids, Mich., has the matter in charge.

Albion, Mich.—The contract for constructing works has been awarded to T. C. BROOKS, of Jackson, Mich. The contract price is $36,800. The stand-pipe and engines will be furnished by the Lansing (Mich.) Iron & Engine Works.

Wyandotte, Mich.—Consulting Engineer J. D. COOK, of Toledo, O., informs us that contracts for the new works have been awarded as follows:

Pipe and specials: Addyston Pipe & Steel Co., Cincinnati, O. Pipe, 815.6 tons, $25.38 per ton; specials, 19.5 tons, 2¾ cts. per lb. Total bid, $21,530.46.

Pipe laying: W. H. Myer & Son, Hillsdale, Mich., 4-in., 13 cts. per ft.; 6-in., 15 cts. per ft.; 8-in., 19 cts. per ft.; 10-in., 23 cts. per ft.; 12 in., 27 cts. per ft.; 14-in., 33 cts. per ft., or 41,296 lin. ft. 14 to 4-in. in diameter for $6,808.20.

Hydrants: Galvin Brass & Iron Works, Detroit, Mich., 65 2-nozzle 5¼ ft. hydrants, 5-in. water way, with frost cases, $27.50 each; 20 3-nozzle 5¼-ft. hydrants, 5¼-in. water way with frost cases, $29.50 each. Total, $2,377.50.

Valves: Galvin Brass & Iron Works, Detroit, Mich. 18 4-in., $8 each; 19 6-in., $12 each; 7 8-in., $18 each; 3 10-in., $24 each; 2 12-in., $34 each, and 1 14-in., $50. Total, $688.

Machinery and boilers: Hughes Steam Pump Co., Cleveland, O.; 2 compound condensing horizontal direct-acting duplex plunger pumps, each having 2 high pressure cylinders, 14 ins. in diameter, 2 low pressure steam cylinders 20 ins. in diameter, 2 water plungers 12 ins. in diameter, all with 18-in. stroke.

Independent condenser, also 2 boilers 54 ins. in diameter by 14 ft. long, shells ⅝ in. thick, heads ½ in. thick, with 42 4-in. tubes, steam dome 30 ins. in diameter by 40 ins. high.

Price for above machinery and boilers, set up, including settings, foundations, all piping inside building and all appurtenances, $6,930.

Submerged suction pipe and crib: Geo. H. Breymann, Toledo, O. Laying 300 lin. ft. pipe, 16 ins. in diameter $4 per lin. ft.

Crib as per plans, $300 complete. Riprap, $1.50 per cu. yd. in place. Total bid, $1,810.

Alton, Ill.—The difficulties between the city and company have been adjusted, and the City Council has ordered the $8,000 due the company paid.

Bushnell, Ill.—A contract for building works has been let.

Mount Pulaski, Ill.—J. M. HOPKINS, Superintendent, informs us they contemplate laying 10 miles of 8, 6, and 4-in. mains.

West Depere, Wis.—The city will probably purchase the works from the company. The quality of the present supply is unsatisfactory.

Ripon, Wis.—Bids for constructing, operating and maintaining a complete system of works will be received until Aug. 26. [Requirements and quantities were given in our last issue, p. xxii.—ED.]

NORTHWESTERN

Coon Rapids, Ia.—A vote will soon be taken on the question of constructing works.

Genoa, Ia.—Works are projected.

Superior, Minn.—The company has offered to sell its plant to the city for $200,000.

Minneapolis, Minn.—The water committee has decided upon the extensions for next year.

Smith's Center, Kan.—The bonds recently voted for establishing new works have been sold, and work will probably begin soon.

Kansas City, Kan.—An ordinance providing for mains on Tenth St. has been passed by the Council.

Ellsworth, Kan.—THOMAS J. NOBLE, Superintendent, sends us the following:

The town contemplates putting in a system of driven wells. About one mile of mains will probably be added this fall. J. D. LAFFERTY is Mayor.

Junction City, Kan.—An additional supply of about 500,000 galls. per day has been obtained from wells. The pumping station is to be moved and about one mile of mains laid. Estimated cost, $15,000. C. P. FOGELSTROM is Mayor. Superintendent C. T. WISLER.

Lansing, Kan.—DAN STORRS, Superintendent has sent us the following:

We shall be in the market for new pumps and boilers next month. The pumping capacity is to be doubled. The works are owned and operated by the State.

Argentine, Kan.—The Pond Engineering Co., of St. Louis, has been awarded the contract for erecting the pumping station, and furnishing and placing in position the machinery for the new water-works and electric light plant. The machinery will consist of two 1,250,000-gall. compound condensing pumping engines, two 100 H. P. tubular boilers, one 90 H. P. Armington & Sims engine, feed pump, heater, furnaces, and all pipe work complete.

Blue Rapids, Kan.—The city is now offering $12,000

of bonds for sale. Plans and specifications have been ordered, and contracts will probably be let soon.

Crawford, Neb.—Only three votes were cast against the projected works. Propositions will probably be wanted soon.

Hooper, Neb.—A special election will be held on Aug. 24 to vote on the question of issuing bonds.

Oakes, Dak.—The town has voted to issue bonds for sinking an artesian well.

Yankton, Dak. — L. KARR, Superintendent, informs us they are laying 3 miles of mains, and are to set 13 additional hydrants.

Fort Pembina, Dak. — Lieut. LEON S. ROUDIEZ informs us they contemplate setting 4 hydrants and building a small reservoir.

Helena, Mont.—The City Council has voted in favor of the city building, owning, and operating its own works. City Engineer MILLER has presented plans for four available sources of supply, which are to be thoroughly investigated, and the most feasible one will probably be adopted.

Great Falls, Mont.—The new wor s have been satisfactorily tested. A pressure of 95 to 1(lbs. was obtained.

SOUTHWESTER .

St. Charles, Mo.—W. L. VICK, Superintendent, informs us they contemplate erecting a steel stand-pipe 20 ft. in diameter by 85 ft. high.

Texarkana, Ark.—The company is to sink ten additional Wagner wells, and lay three miles of mains.

Cisco, Tex.—J. BEALL is to provide a water supply.

Houston, Tex.—Well No. 13 has reached a depth of 132 ft. Mr. Warnecke is the contractor. Artesian wells are to furnish the entire supply, instead of the river as heretofore.

Henrietta, Tex.—We have received the following from J. B. HOPKINS:

The contract for works will probably be let by the Henrietta Improvement Co. in the spring of 1890. The supply to be taken from artesian wells. Estimated cost, $50,000. Address J. H. FERRIS, President. Population, 3,000.

Mexia, Tex.—JOHN R. CORLEY, Secretary and Superintendent, informs us they will make the following extensions and improvements next year:

Add new and larger boilers; extend the mains; improve and increase the water supply generally. Also that they may erect a new stand-pipe.

Cuero, Tex.— Bids for constructing works will be opened on Sept. 15. Plans and specifications can be obtained from H. F. HILL, Mayor.

Dublin, Tex.—A company is being organized to furnish a water supply. R. H. MCCAIN is Mayor.

Trinidad, Colo.—W. B. CUNNINGHAM, Secretary, sends us the following:

Extensive improvements are to be made. The new supply will be taken from the mountains, about 11 miles from and 400 ft. above the city. The gravity system will be adopted instead of pumping, as heretofore. Materials are now on the way, and work will be commenced in a few days.

Cascade, Colo.—D. N. HEIZER, President, informs us that they are to lay 4 miles of mains.

Crested Butte, Colo.—D. J. MCCANNE, Superintendent, of Gunnison, Colo., sends us the following:

Works are being built by the Crested Butte Light & Water Co. They will be completed about Oct. 1. An 8,500 ft. conduit with 290 ft. fall, will convey water from Coal creek to a reservoir of 2,000,000-galls. capacity. The city will pay $100 per year for each of 12 hydrants. Estimated cost, $16,000. The officers are: H. C. WRIGHT, President; S. S. METZLER, Secretary and Treasurer; D. J MCCANNE, Superintendent.

Montrose, Col.—The question of water supply from artesian wells is being discussed.

Salida, Colo.—The vote on the question of issuing $30,000 of bonds for purchasing King's springs and generally extending the works, resulted in 211 being cast for and 25 against their issue. Work will be commenced immediately on laying the main to the springs and building a 2,000,000-gall. reservoir, the capacity of the springs for 24 hours.

Grand Junction, Colo.—The new works have been satisfactorily tested.

Colorado Springs, Colo.— An agreement has been reached between the City Council and the Town of Manitou, whereby Colorado Springs will be allowed to lay the desired 16-in. main through Manitou.

Denver, Colo.—It is reported that a company is to be formed to supply the city with water by JULIUS S. WALSH, BEN VON PHUL, DANIEL WALSH, and JOHN A. OCKERMAN, all of St. Louis, Mo. They have purchased the water rights, known as "Chicago Lakes," which are 14,434 ft. above the level of the sea and located on the Missouri Pacific R. R., 50 miles from Denver, near "Ten Mile Cañon." Water is to be conveyed by gravity through an aqueduct.

The Colorado Cement Pipe Co., of Denver, has recently shipped 6 carloads of pipe to the plant of the Denver Water Co. in Cherry creek. This pipe is to supplant the wooden mains formerly used and by securing the under-flow will supply the city with pure clear water.

Santa Fé, N. M.—It is reported that ROBERT E. CARR, of St. Louis, President of the company, has decided upon a plan for increasing the supply. Extensive additions and improvements will be necessary, if reports are true, to make the present system equal to the demands.

PACIFIC.

Seattle, Wash.—The question of water supply is being actively discussed. Part of the councilmen have expressed themselves in favor of engaging a competent engineer to report upon the question, and part are in favor of at once negotiating with the Spring Hill Water Co. for the purchase of their plant. Meanwhile, JOHN S. MAGGS and others have been granted permission to establish private temporary systems, under certain restrictions.

Enterprise, Ore.—Works are to be established; $2,500 has been subscribed, and the remaining amount necessary to build complete works will be subscribed as soon as contracts can be made.

Albina, Ore.—A proposition from the Albina Water Co., to construct works, has been referred to the Fire and Water Committee.

La Grande, Ore.—A proposition to establish works has been made to the town by the Superintendent of the Eau Claire, Wis., water-works. The present supply is reported as inadequate, and his proposition will probably be accepted at the next meeting of the Council.—— The Hydraulic Water Co.'s plant has been partially destroyed by fire.——Bids will be received until Sept. 4, for establishing a complete system of works. The members of the Special Water Committee are: J. K. ROMIG, DAVID BAY, and J. F. BAKER.

Portland, Ore.—Wolff & Zwicker have been awarded the contract for furnishing and laying 4¼ miles of 24-in. wrought-iron pipe at $85,000. The contract for 48 tons of cast-iron pipe was awarded to Shickle, Harrison & Howard Iron Co., of St. Louis, Mo., at $45 per ton. For furnishing a 10,000,000-gall. Gaskill pumping engine, to the Holly Mfg. Co., of Lockport, N. Y.

San Diego, Cal.—The San Luis Rey Flume Co. will probably lay a 36-in. main from its reservoir in Bear valley to supply the city with water. Bonds for $500,000 have been issued. Chief Engineer, F. P. MCCRAY, Consulting Engineer, BENJAMIN S. CHURCH.

Los Angeles, Cal.—The Special Committee on Water Service has reported that the company is making preparations to greatly improve the city's service, and is to add considerable additional machinery.

Corinne and Brigham City, Utah.—It is reported that these towns have granted franchises for works to the Bear Lake & River Canal Co. This company has recently awarded a contract to William Garland, of Kansas City, Mo., for the construction of a canal, from which their supply will be drawn. [See note under "Irrigation, Kansas City, Mo."—ED.]

Winnemucca, Idaho.—The citizens are prospecting for a suitable source of supply for the proposed works.

Malad City, Idaho.—A water supply is to be established. [See note under "Irrigation, Kansas City, Mo."—ED.]

CANADA.

Woodstock, N. B.—We have received the following from D. MUNRO, Superintendent:

Plans and specifications for a new stand-pipe have been prepared. It will be 35 ft. in diameter by 40 ft. high, and may be erected this fall. In connection with its erection 1,400 ft. of 10-in. pipe will be required, with the necessary valves, etc.

Montreal, P. Q.—Bids will be received on Aug. 27 for constructing a culvert under the Grand Trunk railway, near the pumping station. B. D. MCCONNELL is Superintendent.

Toronto, Ont.—Proposals for furnishing three sluice gates, 350 ft. 6-in. steel pipe, and laying pipe for the intake extension, will be received on Aug. 26. Address JAMES B. BOUSTEAD, Chairman Water-Works Committee.

St. Thomas, Ont.—City Engineer HASKINS, of Hamilton, Ont., has been engaged to report upon the capacity of Locke springs, as a source of supply, as well as the cost of pumping its water to the city.

Chatham, Ont.—If works are established, the supply will be taken from driven wells.

Shelbourne, Ont.—We are indebted to F. G. DUNBAR, City Clerk, for the following:

Works are to be established. The town is now advertising for bids for pipe laying, hydrants, etc. Water is to be pumped by a windmill from an artesian well to a tank. The well has been sunk, but not satisfactorily tested. The Ontario Pump Co. has been awarded the contract for sinking the well, and furnishing the tank and windmill at $8,000.

ARTESIAN WELLS.

Belleville, Ill.—A well is to be sunk at the Star Brewery at once. The engine and machinery is on the ground.

Parker, Dak. — The town has voted $4,000 of 10-year 6 per cent. bonds for sinking a well. Bids will be received until Sept. 9. Address F. L. CLISBY, Village Clerk.

Montrose, Dak.—Address the Town Clerk for information regarding the projected well.

Iroquois, Dak.—A vote will be taken on Aug. 26, on the question of issuing bonds to sink a well.

Elk Point, Dak. — A contract for sinking a well has been let.

Buffalo Gap, Dak.—A well is being sunk.

Aberdeen, Dak. — Numerous wells are being sunk in Aberdeen and vicinity.

Gettysburg, Dak.—Two wells have been sunk at an expense of $7,000.

Dublin, Tex.—A 2,000-ft. well drill is reported to be wanted by the company now being organized to supply water and gas. R. H. MCCAIN is Mayor.

San Angelo, Tex.—The Titus Machine & Tool Co. has been awarded the contract for sinking a well.

Harney, Oregon.—A stock company will probably be organized to sink a well.

IRRIGATION.

Kansas City, Mo.—The contract has been awarded for the construction of a canal from Bear lake, in Idaho, to Ogden, Utah, by JOHN R. BOTHWELL, of New York, President of the Bear Lake & River Canal Co., of Utah, to WILLIAM GARLAND, of Kansas City, Mo. The cost of canal and irrigation reservoirs will be about $3,500,000. The company controlling this enterprise has made arrangements to dam the outlet of Beaver lake, which now has an area of 69 sq. miles and an average depth of 200 ft., so as to give it an additional depth of 10 ft. The canal is to be constructed along the Cache valley to the towns of Malad, Brigham City, Corrinne, and Ogden, an entire distance 150 miles. The company has secured franchises for water-works at all of these places, except Ogden, where they have purchased the franchise of a local company. They will supply these towns and put in irrigation reservoirs all along the line. Two miles of the tunnel will be constructed almost wholly of iron, at an estimated cost of $750,000. The entire work is to be completed by April 1, 1890.

Sterling, Colo.—A dam is projected, to be built across Pawnee creek, at Pawnee pass 12 miles from Sterling. A committee has been appointed to take charge of the preliminary surveys and all matters pertaining to the project. If carried out, it will reclaim 25,000 acres of land.

Spring Hill, Mont.—A certificate of incorporation of the Spring Hill and Red Rock Reservoir and Irrigation Co. has been filed at Helena, Mont. The incorporators are: L. C. FORD, REES FREEMAN, T. E. JULIAN, C. T. STEWART, and W. F. KIRKWOOD. The company proposes to build and maintain dams and reservoirs for storing 3,000,000 galls. of water, for reclaiming lands along Red Rock creek and Lower Red Rock creek and in Beaverhead county. The capital stock is $750,000, divided into 75,000 shares. The trustees are L. C. FORD, CHARLES T. STEWART, and W. F. KIRKWOOD.

Milwaukee, Wis.—The X. Y. Irrigation Ditch Co. has signed articles of association with Secretary of State Rice. The capital stock is $15,000. The directors for the first year are: F. F. HARVEY, DAVID BENJAMIN, and S. B. SNYDER. Operations are to be carried on in the Prowers county.

Blackfoot, Idaho.—The *News* states that a company of capitalists is to build a 40-ft. canal from Snake river, below Market lake, and run it to the foothills east of Eagle Rock, thence southerly towards Basalt and Blackfoot. Their object is to reclaim all the lands north of Eagle Rock, as well as the lands lying east of the railroad between Eagle Rock and Basalt.

Cascade, Mont.—The first section of the Chestnut valley canal, about ten miles in length, has been completed. Chief Engineer J. D. MCINTYRE has let the contract to extend the canal five miles further and to complete the solid rock work in the Half Breed cañon. The line of the canal covers the whole Chestnut valley opposite Cascade. The Company has contracted with the farmers to rent all the water they can furnish.

Great Falls, Mont.—The Montana Artesian Well and Dam Co. is being organized to provide an adequate and constant supply of water for general purposes on bench lands.

Wyoming.—The Sweetwater Land & Improvement Co. has been incorporated. Capital stock, $300,000. It proposes to deal in land and water rights in the Sweetwater valley.

Helena, Mont.—S. W. LANGHORNE, Registrar of the Land Office, has been instructed by the Secretary of the Interior to refuse applications for filings and entries on the following lands, which have been selected as reservoir sites:

Sections 21 and 22, township 9 n., range 2 e.
Section 12, township 9 n., range 2 w.
Sections 7 and 8, township 9 n., range 3 w.
Sections 18 and 19, township 18 n., range 6 w.
Sections 13 and 24, township 18 n., range 7 w.
Sections 5 and 6, township 22 n., range 4 e
Section 17, township 25 n., range 6 w.
All of township 22 n., range 3 e.
All of township 26 n., range 7 w.

Anaheim, Cal.—The cost of the projected system of the Anaheim Irrigation District Directors is estimated at $440,000.——It is also reported that the Wright Irrigation District is negotiating for the purchase of the Union and Yerba water companies' plants, and if successful in securing their water rights, will establish a plant costing between $300,000 and $400,000.

San Diego, Cal.—The San Luis Rey Flume Co., proposes to lay a 36-in. pipe from its reservoir in Bear Valley, through San Pasqual, San Bernardo, Poway and Los Penasquitos valleys, and over the Linda Vista Mesa the ex-Mission rancho, and cross the San Diego river north of University Heights, a distance of 40 miles, to irrigate 100,000 acres of land. It has placed $500,000 of bonds in Chicago. E. P. MCCRAY is Chief Engineer of the company, and BENJAMIN S. CHURCH Consulting Engineer.